PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

APRIL 1957

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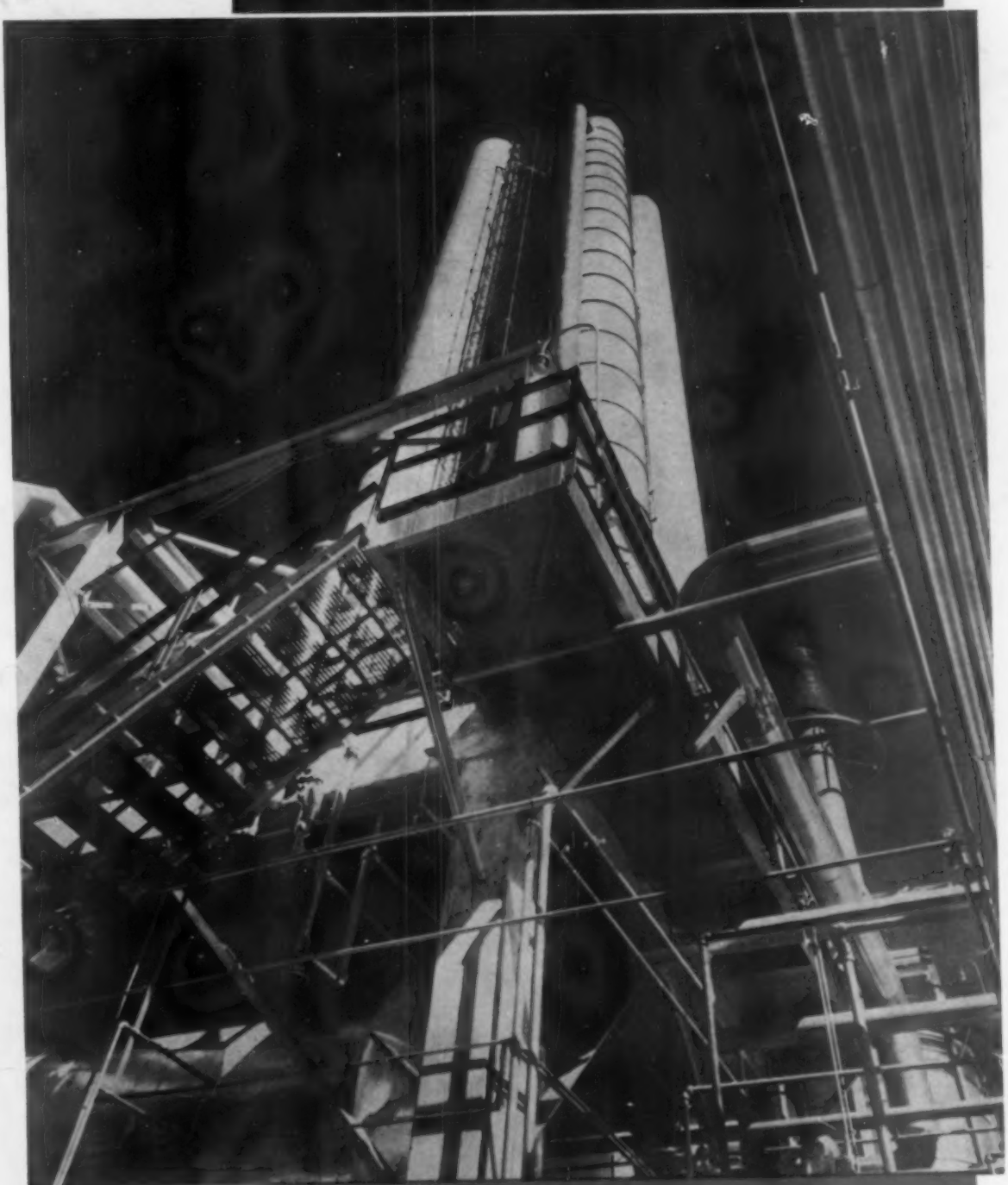

DIRECT-RECOVERY METHOD USED IN COSDEN PETROLEUM'S NEW STYRENE PLANT IN TEXAS

See news story/page 306

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University of Michigan
Ann Arbor, Mich.
12/57

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PLASTICS TECHNOLOGY

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Article

Highlights

Color Variations in Coatings for Plastics. (p. 277)

Causes of color varitions in pigmented paint films, and their correction, are discussed in detail. Application problems, such as powder settling, powder leafing, and flooding, are covered. Consideration is given to the problems of changing substratum color, color matching on wrong surface, color bleeding, and changes in color standards.

•

Heat Stability Test for Vinyl Calendering Compounds. (p. 280)

Details of a test that defines heat stability of a compound in terms of initial color, color degradation rate, and ultimate stability. Rapid and using only small amounts of material being calendered, the test is particularly adapted to development and control work on foundations.

•

How to Select a Plastics' Brand Name. (p. 283)

Pitfalls to be avoided and precautions to be taken in the selection and proper use of a brand name are described. These will result in a strong, valid brand name that can be protected against infringement.

•

Heat-Distortion Properties of Polysulfide Polymer-Modified Epoxy Resins. (p. 291)

Comprehensive test data are presented to show that a wide variation in heat distortion temperature of flexibilized epoxy resin systems can be obtained, depending on flexibilizer: resin ratio, resin used, amount and type of curing agent, cure time and temperature, and aging time.

Previews

The following four technical articles will be published in our May issue:

Importance of Mold Rigidity in Injection Molding. R. N. Farris and P. J. Meeks, plastics technical service engineers, Dow Chemical Co., Midland, Mich.

How to Predict Extruder Performance with Polyethylene. B. H. Maddock, development engineer, Bakelite Co., Bound Brook, N. J.

Plastics in New Product Design. Edward Ferrari, model shop supervisor, Industrial Design Section, Housewares and Radio Receiver Division, General Electric Co., Bridgeport, Conn.

The guest editorial in May will be **"Do You Have to Go to Court?"** by H. L. Bullock, engineering consultant, New York, N. Y.

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Letters to the Editor

Comparing Material Property Data

Dear Sir:

Your editorial in the October 1956 issue ("Comparing Data on Material Properties") was very interesting and timely. Much of the confusion on reporting property information on plastics would disappear if (1) all those in the industry would read and use the report section of the ASTM methods they reference, and (2) those who find defects in the methods would do a little work and help revise them.

ASTM Committee D-20 on Plastics welcomes suggestions concerning improvements in their methods of test and specifications. All will be given serious consideration. However, those who make suggestions should be willing to work on the problems that interest them. Progress can only be made on each problem when there are three or more individuals sufficiently interested to do more than talk. It is very easy to point at problems; it is sometimes very difficult to solve some problems. We need and welcome members who are sufficiently interested to work.

It is amazing to me at times to receive inquiries from technical personnel of industrial concerns, research institutes, and universities asking some simple questions that are clearly answered in current ASTM and Federal test methods. Either they are unaware of the pertinent literature in their field, are too lazy to read the methods, or do not understand what they read.

It is sometimes apparent that reports containing garbled data were carelessly written or were written by advertising or sales personnel with little knowledge or interest in scientific accuracy.

One psychological factor that should be considered is the belief among many people that because a value for a certain property of X's material is higher or lower than Y's material, that X's material is better or worse than Y's material. This is not necessarily true. A material cannot be categorically described as superior or inferior to another on the basis of property values alone. Specific property values for one material may be higher or lower numerically than that of another, but superiority or inferiority can be assessed only on the basis of a particular application. For example, one application may require a material with a high tensile elongation, whereas for another a material with a low tensile elongation would be more satisfactory. Also, a relatively low tensile strength asphalt treated paper and higher tensile strength polyethylene film are both suitable for ground covers and interior wall insulation in buildings. It is evident that tensile strength must be interpreted in a new light to resolve the apparent anomoly. Such an interpretation is not difficult to develop. It is quite evident that materials for a given application must be selected on the basis of the relation of property values to the service conditions involved and the design of the part.

Although the conclusion given in your editorial may be considered harsh it is one that must be given serious consideration in addition to those I have given above. The plastics industry would be in a sounder position if standardization were given more attention and placed on the highest technical level by more of those working in and concerned with the industry.

F. W. Reinhart, Chairman,
Committee D-20 on Plastics, A.S.T.M.

(We can only applaud and concur in Mr. Reinhart's views. The conclusion to which he refers in the last paragraph was: "The only logical reason for existence of such non-uniform property data is that it permits a supplier to conceal or camouflage the fact that his material is inferior to another material in a certain property."—Editor)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation, and address.

A letter will not be printed if publication is not desired by the sender.

Letters requesting information on technical or engineering problems will be printed to elicit replies by the readers, either directly or through these columns. Upon request the identities of such "problem" letters will not be divulged.

"Quote . . . Unquote"

The Polyethylene Derby

"Much has been said in the public press and trade magazines about the phenomenal growth in polyethylene production over the past 15 years, from pilot plant production to perhaps the largest single volume plastic material in the very near future. . . . Several years ago when the existing producers and some newcomers announced plans for new plants to produce this 'squeeze bottle' plastic, the term 'polyethylene gamble' was used in reference to these plans for increased production capacity.

"A new series of expansions announced over the past two years has led to the term 'polyethylene derby,' which may be a good analogy. There are now or soon will be several types of material or production processes being used. The old-timer popularly known as the 'high-pressure' or 'low-density' material is still the backbone of the industry and the only one being produced in large volume today. And . . . it is here to stay. But new types . . . . are now being developed and production plants for these types are under construction . . . . It has been estimated that polyethylene production, in the near future, will reach a billion pounds per year."

F. H. Carman, Tech. Director, Manufacturing Chemists' Association, Inc. Washington, D. C.

• • •

Automation Defined

"While we have in automation a new word that is not yet used with very much consistency, the more serious students of the subject have managed to reduce it to cover about three different types of very 'progressive' manufacturing:

"The first is the installation of new and more complicated machine tools which perform as one operation processes that had previously been performed as a long series of separate operations by a long series of separate machine tools each individually operated . . .

"Another type of innovation usually described as 'automation' is the use of automatic 'feed-back' devices or 'servo-mechanisms' . . . that automatically adjust the operation so it will not vary from pre-set specifications.

"A third type of change . . . is the use of electronic devices in administration and engineering to record, store, process, summarize, and interpret information.

"Automation, therefore, is not one thing but three or more separate things."

M. P. Ferguson, President Bendix Aviation Corp., Detroit, Mich.

• • •

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*BETTER QUALITY — BETTER SPEED — BETTER PROFITS.

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*Precise Lateral Movement Guidance — Completely Automatic * Covered with Soft, Sure "MH-31" for Gentle, Safe Handling.

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Write for PRECISION GUIDERS Folder #8793

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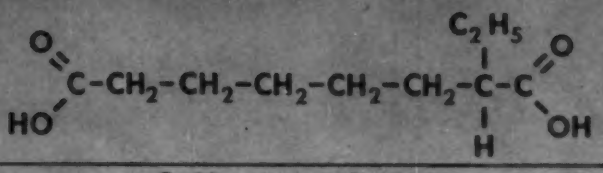
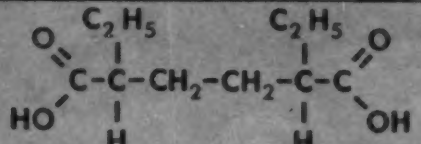
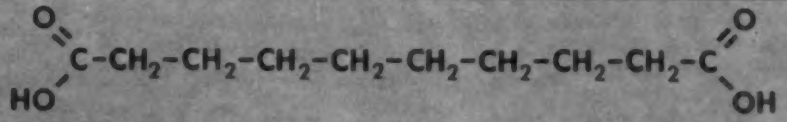
U.S.I. ISOSEBACIC® ACID

a new intermediate for vinyl plasticizers, polyurethanes, polyamides, polyesters, alkyds

a mixture of SEBACIC ACID ISOMERS

2- **ethyl suberic acid**		72 to 80%
2,5- **diethyl adipic acid**		12 to 18%
sebacic acid		6 to 10%

U.S.I. ISOSEBACIC Acid lowers costs and improves performance when used as an intermediate for:

(1) vinyl plasticizers — gives excellent low-volatility, non-migration and low-temperature characteristics.

(2) polyurethane foams, (flexible and rigid).

(3) polyamide (nylon type) molding and extrusion plastics.

(4) polyester resins used in glass-reinforced plastics—gives improved flexibility.

(5) alkyd resins — imparts flexibility and water resistance to surface-coating film.

U.S.I. ISOSEBACIC Acid is a mixture of C_{10} dibasic acids which is now offered in pilot plant quantities at a development price of 45¢ a pound. Full-scale production prices will be even lower.

This new intermediate is a white crystalline solid with the following physical and chemical properties:

PHYSICAL PROPERTIES

Molecular weight	202.24
Combining weight	101.12
Density (80°C)	1.025 g/ml 8.55#/gal
Melt viscosity (80°C)	78.5 centipoises
Specific heat of vapor (226°C)	0.34 cal/g (est.)
Heat of vaporization (226°C)	107 cal/g
Specific heat of solid (24°C)	0.33 cal/g
Heat of combination	1296 K cal/mole
Flash point (closed cup)	430°F
Ionization constant at 25°C	$K_1 = 3.5 \times 10^{-5}$ $K_2 = 5.1 \times 10^{-6}$

CHEMICAL PROPERTIES

1. Undergoes typical reactions of the dibasic acids.
2. Reacts with alcohols to yield both acid and neutral esters.
3. Reacts with basic materials to give acid and neutral salts.
4. Relatively stable material, not oxidized by air at ordinary temperatures.

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NEWS in BRIEF

New process for bonding Mylar polyester film to a variety of rigid and flexible materials has been developed by Seiberling Rubber Co. A special thermosetting adhesive is applied to the surface of the material being covered, the film placed into position, and heat and pressure applied by means of a special flat-bed press. The bonded "laminate" can be reshaped without damaging the film. The process also can be used with embossed Mylar film.

Melamine dinnerware molders have formed a new organization, the Melamine Council, to stimulate dishware sales. Formed by 17 molding companies, the Council is pledged to maintain and promote the best interests of melamine dinnerware manufacturers, Membership is open to all who produce, mold, or fabricate the plastic dinnerware.

Plastic films and their use in color packaging are discussed by D. S. Threlkeld, director of research for Clopay Corp. (see guest editorial, page 289). While noting the great strides made by polyethylene film in the packaging field, he questions whether there is any polyethylene film on the market today that can portray color depth as well as do cellophane, vinyl, Mylar, and acetate films.

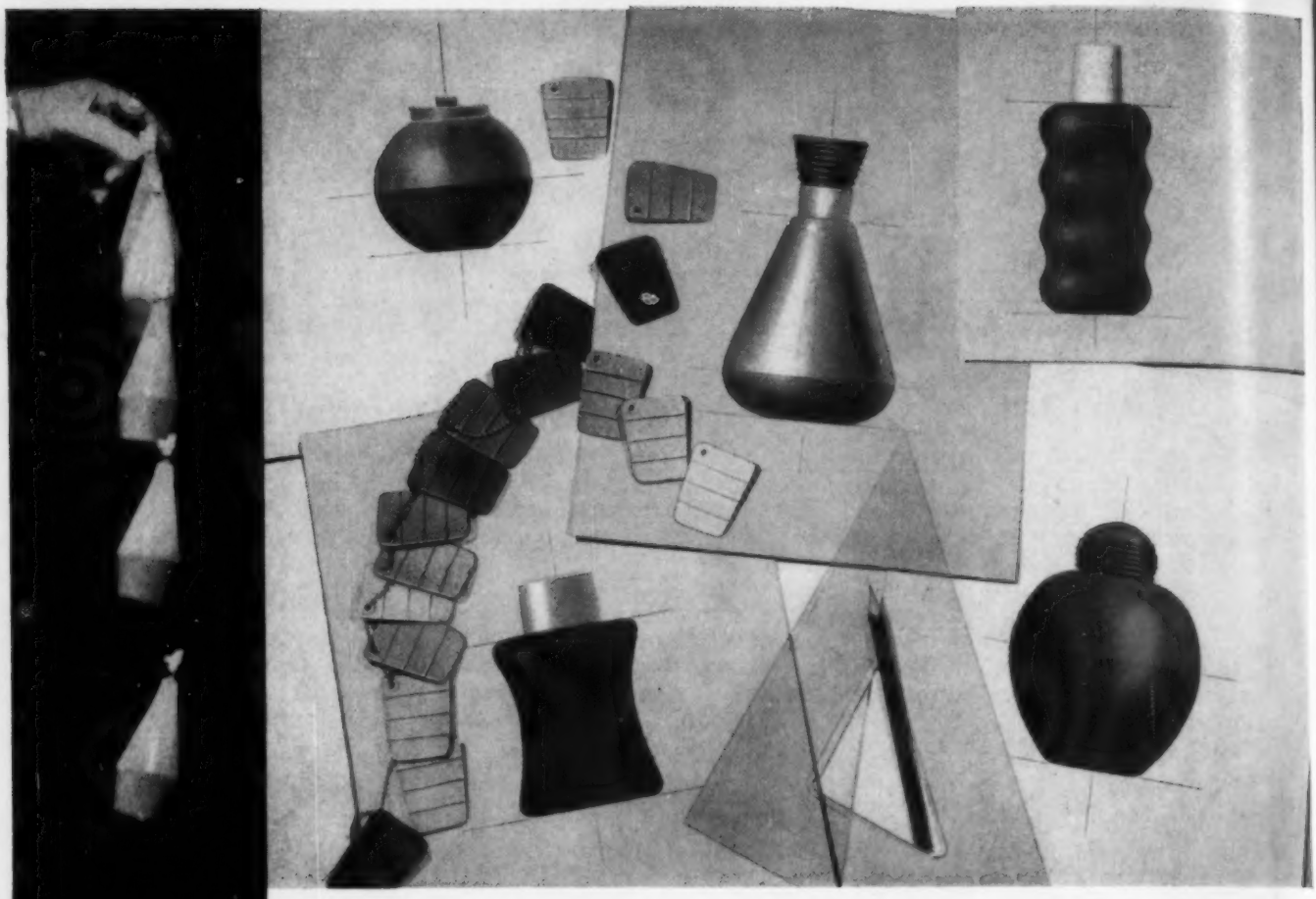
Company expansions in the news this month feature two major firms. Borden opened its new West Coast formaldehyde plant in Kent, Wash., and announced plans for a $150-million expansion and modernization program of its physical facilities over the next five years. Du Pont opened a $2-million industrial products lab in Newport, Del., for market development of its man-made fibers, and the company plans to build a $1.5-million addition to its polychemicals experiment station near Wilmington, Del.

Company developments in the plastics industry were varied in nature. Catalin formed a new chemical division, and realigned its plastics materials sales on a divisional basis. Corruplast, Inc., opened a new plant in Passaic, N. J., for the extrusion of rigid PVC pipe, ducts, and sheet. Cosden Petroleum's new plant at Big Spring, Tex., went into operation, making styrene by conversion of ethyl benzene produced by the direct-recovery process from gasoline. Durez plans to market light-colored polyester molding compounds, processable with standard phenolic dies and molding equipment, in commercial quantities this fall. Heyden Chemical purchased Newport Industries, Inc., which will operate as a division of the parent firm, Heyden Newport Chemical Corp. U. S. Rubber sold its wire and cable business to Kaiser Aluminum & Chemical Corp.

New Materials to be noted (see pages 314-16): reactive allyl monomer; two epoxy coating resins; heat-resistant, rubber-modified polystyrene molding compound; epoxy casting resin and a foam-in-place material; non-woven, felt-like fabric with resin impregnation; acetal resin molding powder; plasticizer and intermediate; and nylon resin with form-stability in the molten state, and high stiffness and toughness in finished products.

New Equipment worthy of mention (see pages 317-9): two dry-tumbling units; bench-model insulation sleeving cutter; thickness tester for extra-thick sheets, including foams; replacement electric heater bands for injection cylinders; cycle controller for hydraulic molding presses; particle size tester; and mechanical brushing machine for continuous webs of plastic material.

New Products of special interest (see pages 320-22): all-plastic thermos bottle; glass-reinforced epoxy hydrofoils for boats; vinyl plastisol coated marine items; color-coded gasket and shim stock; three filled epoxy pastes; two-man inflatable vinyl boat; standard, one-piece, corrosion-resisting tanks; fire-resistant thermoplastic sheet material; molded urea sockets for nine-pin electronic tubes; aircraft skis covered with fluorocarbon resin film; extruded polystyrene diffuser for fluorescent light fixtures; polyurethane foam materials; and calendered linear polyethylene films.



New colorful styles... attractive designs for aerosols

with Du Pont ZYTEL® nylon resin

Now, by using ZYTEL nylon resin, plastic molders can produce a wide variety of sales-appealing shapes and color combinations for the packaging engineer designing aerosols. Two new developments are responsible for the expansion of design opportunities.

First of these developments is a new technique for welding two injection-molded sections of ZYTEL, forming a single aerosol unit. This new technique has been found to be an efficient and sure way of joining plastic sections, and enables the designer to create an aerosol package in various attractive colors.

A new grade of ZYTEL, type 42, is the second development. ZYTEL nylon resin, type 42, has the optimum viscosity for extrusion and blow molding. This fabrication method allows great freedom of design, and many unusual shapes are now practical.

A container molded of ZYTEL is impermeable to the propellents used in aerosols. The chemicals in such products as antiperspirants, colognes and hair lacquers will not attack ZYTEL.

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***ZYTEL** nylon resin makes possible new, colorful designs for aerosol containers. A new grade ZYTEL, type 42, and a recently developed fabricating technique are responsible for the entrance of ZYTEL into the aerosol field.*

PLASTICS TECHNOLOGY

APRIL, 1957

EDITORIAL: "Advances in the Technology of Plastics"

Continuing the program of improvements and expansions in PLASTICS TECHNOLOGY during 1957, our third year of publication, this issue marks the inauguration of another new feature, the series on "Advances in the Technology of Plastics."

This series consists of short reports or articles contributed by various members of our Editorial Advisory Board. One such report appears in this issue: "Developments in Plastic Materials—1956," by Gordon Thayer, Dow Chemical Co. Other reports in the 1957 series will be published in the next few issues.

The series will be an annual feature and, in future years, will appear in the first few issues of the year so that the subject matter will be even more timely.

•

It is not our intention that the individual reports be as comprehensive and detailed as possible, nor that they cover all the many phases of plastics technology. There are two major reasons for this selectivity.

Firstly, the individual reports highlight specific development fields as reviews or reminders to our readers in that field. Detailed reviews, also covering current status and future potential, will continue to be covered by occasional technical articles in our regular article section.

Secondly, the six Board members conducting Engineering Forum departments will not be writing reports for the Advances series. They already are doing their share; also, we have suggested to them that they incorporate similar reviews of their fields into their Forum columns each year, preferably into the first installments of their column.

We are very interested in obtaining your reactions to the Advances, the idea for which is based on your many comments and suggestions during our 1956 Survey of Reader Interest.

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This is an excellent opportunity for us to pause and point with pride to the many and continuing contributions of our Editorial Advisory Board to the magazine. While such Boards are common in the publication field, ours is not, especially in that it does not serve only in an honorary or titular capacity. Instead, our Board members contribute actively in many ways. They all are well-known men with more than enough work to do in their regular industrial positions. Their work for us is an added burden, and each man merits our deepest appreciation for his services.

Also, the Board members serve us essentially as individuals, rather than as representatives of their companies, and their company affiliations have not been given any particular publicity. In expressing our thanks to the Board, we must also note our appreciation of the Board member companies for their courtesy and assistance in our efforts to promote plastics as engineering materials designed to meet the requirements of specific applications, rather than as novelty or glamorous materials.

Arthur M. Merrill

Editor

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PLASTICS TECHNOLOGY

Color Variations in Coatings for Plastics

A discussion of color variations in plastics coatings, their causes and corrections.

M. A. SELF, *President, Logo, Inc., Chicago, Ill.*

THE human eye is more sensitive to color than is commonly supposed. We can detect very minute differences between colors in adjacent areas. Colors differing only slightly are not likely to be harmonious when placed next to each other and, therefore, are usually unpleasing to the eye. Our color memory, on the other hand, is very poor; hence, the need to establish color standards for control purposes.

In the painting and decorating of plastics, an understanding of the causes of color variations from the standard, and how to correct for these variations is, therefore, a valuable aid in the production of painted parts with minimum rejections and cost. Finishes for plastics, with or without color, are divided primarily into two classifications: functional, and decorative.

A functional finish is designed to provide a surface property that the plastic needs, but does not have otherwise. This may be resistance to chemicals, water, abrasion, or solvents or an electrical characteristic. In many cases, this finish may be simply a clear protective coating. The functional finish also may be used to hide surface blemishes or mottled colors caused by using rough molds or downgraded material. In these cases, the finish usually is pigmented or a pigmented metallic, and may serve both functional and decorative purposes.

A decorative finish is designed to enhance the appear-

Madison A. (Al) Self was born in Kansas in 1921. He attended the University of Kansas, receiving a B.S. in Chemical Engineering in 1943. From 1943-1944, he worked in the engineering department of the York Corp., now a division of Borg-Warner. He joined Sharples Chemicals, Inc., in 1944 as a member of the research department, and was with the company's sales and development staff during 1946-1948. He joined Bee Chemical Co. in 1948 as sales manager, and became president in 1949. In addition to this title, he has been board chairman of Bee Chemical since 1956. He has been president of Logo, Inc., a wholly-owned subsidiary of Bee Chemical, since its inception in 1952.

In his work, Mr. Self has been particularly instrumental in research and market development of coatings for plastics and vacuum metallizing finishes. He is a member of SPI, SPE, the American Chemical Society, and the American Institute of Chemical Engineers. In 1954, he was president of the SPE Chicago Section. Mr. & Mrs. Self have a son, and currently reside in Hammond, Ind.

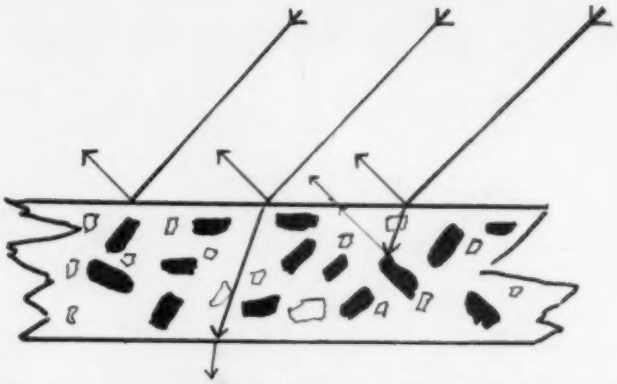

Fig. 1. Cross-sectional diagram of light entering a low-loaded, pigmented paint film containing both transparent and opaque pigment particles. A portion of the light is absorbed; another portion is reflected; and a final portion is transmitted.

ances of the part, and may or may not be applied to the entire visible surface area of the item. The decorations may be used to identify the product, to provide multiple colors and designs, to accent letters or numerals, or to produce a uniform color for an assembly of plastic parts when an exact color match is otherwise difficult to achieve.

Pigmented Paint Films

A paint film whether functional or decorative, consists essentially of pigment and resin. Visual properties of the film are dependent on the interrelated effect of the three items; pigment, resin, and light. When light strikes a pigmented film of paint, some light is reflected and some is absorbed and converted to another form of energy (see Figure 1). If the plastic is clear, some light may be transmitted through the film. When the pigments absorb a wave-band of light and convert it into another form of energy, the remainder of the light is either reflected back to the eye or transmitted through the film.

The color of the light reaching the eye will depend upon the particular wave-bands not absorbed. If all the light were reflected by the pigment, we would see a perfect white. White pigments always have various color undertones; e.g., the yellow in rutile titanium dioxide. If all the light were absorbed, we would have a pure black. Commercially, even the best blacks, such as carbon black, reflect a certain amount of light; hence, carbon black has a slight gray quality.

The reflection and absorption of light is responsible for the opacity of a pigmented paint film. The reflection depends on the difference between the refractive indices of the resin binder and the pigment. If the difference is great, the light bends as it passes successively through the binder, the pigment particles, and the binder. Some of the unabsorbed visible light will return to the surface of the film and back to the eye. If the resin binder and the pigment have nearly the same refractive index, most of the unabsorbed light will pass through the film. Such pigments are classified as transparent, and have little covering power.

A color change in a paint film may be noted over a period of time, especially when subjected to outdoor exposure. Only light-stable pigments and vehicles should be employed to prevent such instances, and it is of utmost importance this or any other unusual performance requirement be known at the time the paint is formulated. Few organic pigments have good light stability in tint tone; exceptions would be some of the phthalocyanine and indanthrene colors. Pigments such as non-chalking rutile titanium dioxide white, carbon black and some iron oxides have good light stability. Organic pigments, such as Hansa yellow and toluidine red, have outdoor light stability in mass tone, but will tend to fade out when mixed with titanium dioxide in tint tones. Light stability, may be sacrificed, therefore, when such pigments are blended in color matches.

Often, a color submitted for matching requires the use of such organic pigments, yet must be light stable. It would be necessary, therefore, to sacrifice color-matching accuracy to obtain this durability. This problem can largely be circumvented if the original designer will request light-stable colors and use those in his design. Then, later, color matches can be made with these same pigments.

There are numerous causes of color variations of a type that is readily detectable at the end of the manufacturing sequence. These can be especially troublesome when several sources supply different plastic parts specified to have the same color, with some to be painted. It can become even more involved when these parts have different surface types, such as flat, curved, diamond, etc.

These color variations are usually derived from one of the following sources:

(1) Poor application technique.
(2) Changing or variegated color of substratum.
(3) Color matched to the wrong surface.
(4) Surface design variations.
(5) Color bleeding.
(6) Etching.
(7) Incorrect light used to check color.
(8) Standards changed.

Application Problems

POWDER SETTING. When a gradual change in color is noticed while a batch of paint is being sprayed, powder or pigment settling is most often the source of difficulty. This problem becomes most pronounced with metallics or pigmented metallics. Most spray room personnel are well aware that materials should be mixed or agitated to prior to use. They are not always aware, however, of how far the color can be thrown off by the gradual settling of heavier metallic powders.

If a pigmented metallic paint is mixed and then transferred to an unagitated spray tank, the color would be satisfactory for a while. The first part sprayed would probably be on color, but as the metallic powder settles and the paint is fed into the spray gun from the bottom of the tank, the color will become rich with the powder (or in the case of aluminum, too light in color). On the other hand, too rapid mixing, especially in agitator pressure tanks, can separate the heavy particles in much the same manner as in a cream separator. Whenever there is a color variation and the paint contains heavy particles, such as aluminum and, especially, bronze, improper mixing procedure should always be investigated.

POWDER LEAFING. Bronze powder, in particular, is quite reactive, and has a limited shelf-life in many vehicles. In cases where the bronze powder is not stable when mixed with the vehicle, an alternate material made from aluminum and transparent colors (commonly called a bronzeless gold) is offered. To avoid gelation, it is necessary to mix the required amount of bronze powders with the vehicle immediately prior to use. Bronzeless golds also are frequently specified where the finished part may be subjected to an excessively humid or corrosive atmosphere. Metallic finishes generally, and bronzeless golds in particular, will vary in color depending on how wet or dry the paint is sprayed. A dryer spray usually results in less leafing of the powder, thus giving a darker color.

FLOODING. Color change due to poor application usually involves flooding or separation of pigments in the wet paint film. This usually can be controlled in both lacquers and enamels that contain only milled pigments by proper solvent adjustment. The problem, again, is most prevalent with metallics and pigmented metallics which may contain powders of different specific gravities, and mechanical adjustments in the spraying operation prove helpful.

Flooding in general, is most likely in excessively wet films of low viscosity. Most often, this can be corrected by drying up the spray by increasing the pressure at the gun, moving the spray gun away from the part, or spraying with a wider fan adjustment on the gun. However, the degree to which the spray can be dried up will depend on the amount of high-boiling solvent used. It is best to check whether the recommended thinner is being used.

As a precaution, it is necessary when making the adjustments for flooding that the material is not sprayed too dry. A dry spray will give a different problem in color variation, and frequently has a grainy or roughened surface. When proper thinning ratios and pressures are set up as standard procedure, these problems usually do not re-occur.

Changing Color of Substratum

Many transparent pigments will allow the color of the plastic to show through and affect the tone or color of the paint film. If this paint is used on the same base-type material or over a uniform color, and the film thickness is held constant, the resultant film color will be uniform. If the substratum is changed, the apparent color of the paint film also may change.

It is not always easy to match colors by using only highly opaque pigments, and there are occasions when some transparent or translucent pigments must be used. In cases where the substratum color is uniform, transparent covering pigments usually are satisfactory. This difficulty indicates the importance of matching colors with transparent pigments which must be employed over a plastic of the color to be used in production. The solution would be to spray with an opaque corrective coat, and then follow with the proper top-coat, if engineering or production have gone too far to correct this problem by using a standard color base stock.

Variation in color also may be the result of thin or irregular film thickness which allows the substratum color to show through in patches. Very often, this results from an incorrect balance between different solvents used in the thinner, or from incorrect thinning. Usually, it is best to check your thinning ratio and see if it is being used as specified.

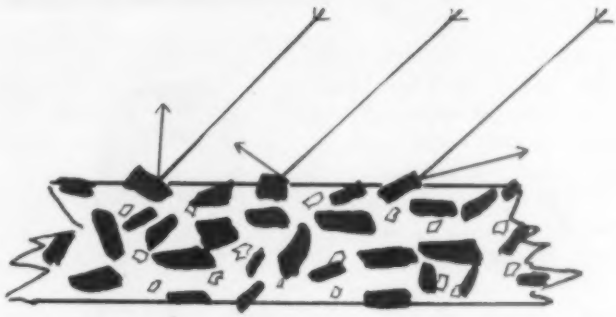

Fig. 2. Cross-sectional diagram of an opaque paint film where all of the entering light is either absorbed or reflected, and none is transmitted. This film is flat because of high pigment loading, and some of the pigment particles extend above the resin surface.

Color Matching on the Wrong Surface

For the sake of brevity, we use two terms, "first surface" and "second surface," to describe the surface on which the finish will be applied. The first surface is the front surface of a molded or sheet plastic, which may be either transparent or opaque. The first-surface finish is intended to be seen on the same side of the molding or sheet on which it is applied. The second surface is the back surface of a transparent molding or sheet. Thus, a second-surface finish is to be seen through the transparent or translucent plastic. In many cases, it also may be decorative when viewed as a first surface finish. In most cases, first and second surface application require different finishes.

A second-surface finish has two major differences from a first-surface finish, and allowances must be made in formulation of the paint. These differences are as follows:

(1) A flat (non-glossy) material may be used on the second surface, with gloss being imparted by the plastic itself (see Figure 2).

(2) Transparent plastics, although supposedly clear, have a color within themselves. For example, polystyrenes may have a slight yellow or blue tinge, and many acrylics have a slight yellow color. It is understandable, then, placing a yellow back-up coat on the second surface of a polystyrene casting might result in green undertones.

Color Bleeding

Bleeding is the migrating of a pigment from one film to another as a result of partial solubility of the pigment in the solvents used. This causes difficulty where two different colors contact one another, or where one paint film is painted over another of a different color (see Figure 3). Batches of parts sometimes are molded from scrap that contains a bleeding dye which may cause trouble, especially if the parts are

(*Continued on page 290*)

F. R. Nissel

G. G. Himmler

Heat Stability Test for Vinyl Calendering Compounds

Details of a rapid, high-speed milling test particularly adapted to development and control work on heat stabilized compounds.

G. G. HIMMLER, *Development Group Leader, Development Laboratories*
and
F. R. NISSEL*, *Chemical Engineer, Development Department*
Bakelite Co., Bound Brook, N. J.

THE heat stabilization of vinyl resin compounds has always been one of the major formulating problems of the vinyl industry. Laboratory tests for the evaluation of stabilizer systems have been in use for many years. In general, these experiments have been based on either an oven test method or on milling tests performed at mill-roll surface speeds of approximately 55 feet per minute. Compound temperatures between 150-180° C. are used or attained in these tests.

With the advent of high-speed calendering of vinyl film and sheeting, very severe demands have been made on the heat stability of the compounds. This is due to the development of compound temperatures far in excess of that of the rolls, owing to the influence of high shear rates. Under these conditions, the standard heat stability tests, such as those run on the normal, slow-speed mills, do not develop much frictional heat.

The observation of banks on production calenders operating at higher roll speeds reveal that these banks have a very fluid and smooth appearance. In contrast to this, observations of standard-speed laboratory mill banks show that these are relatively rough and mealy in appearance at similar mill roll temperatures. The inference drawn from this phenomenon is that high-

*Now sales manager of Prodex Corp., Fords, N. J.

speed calendering banks are far hotter than standard mill banks because of the higher shear rates developed.

About three years ago, it became evident that a test simulating high calendering speeds was necessary. With the use of a newly-acquired multi-speed mill, such a test was developed at the Bakelite development laboratory. Early experiments with this equipment showed that fluid banks similar to those seen on production calenders are produced at the higher speeds.

Heat Stability Test

In view of this observation, an investigation of the factors influencing bank temperatures was undertaken. The variables covered in this work were (1) sheet thickness, (2) roll velocity, and (3) compound stiffness and viscosity.

In order to measure bank temperatures accurately, a bank pyrometer was built which consisted of a needle pyrometer mounted on a rigid frame suspended over the mill. This device permitted the needle to be raised and lowered while the mill was running. During this operation, the needle tip is within ¼-inch of the roll nip at its lower position. Bank temperature measurements were conducted at a mill surface temperature of 170° C., and the banks were maintained at ¾-inch diameter. As expected, it was found that bank temperatures increased with decreases in mill openings. A more striking discovery, however, was the rapid increase in bank temperatures with an increase in mill speed and compound stiffness.

Figure 1 shows the effect of mill surface speed on compound bank temperature. At the slower speeds, the bank temperatures are only 12-18° above the mill temperature, while the higher speeds yield temperatures of 23-63° above the temperature of the mill. It also can be observed that products with less plasticizer content tend to develop substantially higher temperatures.

These observations led to the development of a new mill stability test, based on the higher mill-roll surface speeds.

In performing the high-speed stability test on non-rigid vinyl compounds, the first step is to weight and mix the batches. Conventional laboratory equipment is used for this process. Our standard batch size for this operation is 250 grams, and the batches are stored in polyethylene bags. All the experiments were performed on an 8 by 16-inch multi-speed mill at a surface speed of 166 feet per minute. For non-rigid materials, we have used an average roll temperature of 170° C., maintaining 171° at the front and 169° at the rear. A sheet thickness of 15 mils, as determined on a filled cleaner batch, is maintained. The cleaner batch performs a double service, being used to set up the mill as well as to clean the mill between batches.

After the mill has been set up and the desired thickness determined, the experimental batch is added to the mill. The compound usually follows the front roll. By means of a putty-blade, the compound is scraped from the roll three times. After each scraping, the material is immediately reapplied to the mill. At this point, the batch has been on the mill about 40 seconds. The compound is allowed to run freely on the mill until a total time of one minute has elapsed. Then the mill is stopped, and immediately reversed through a quarter turn.

The sample is taken from the mill by means of a unique molding pliers (see Figure 2). Standard multi-leverage pliers are converted for this purpose by the addition of a mold which is welded onto the jaws. The mold cavity is such as to give a molded plaque specimen 0.100-inch thick and 1⅜ inches square.

As soon as the one-minute specimen has been taken, the mill is restarted immediately, and additional samples removed at two-minute intervals. The procedure for sampling is the same after each interval. Depending upon the nature of the information desired, the test may either be continued until the material turns black,

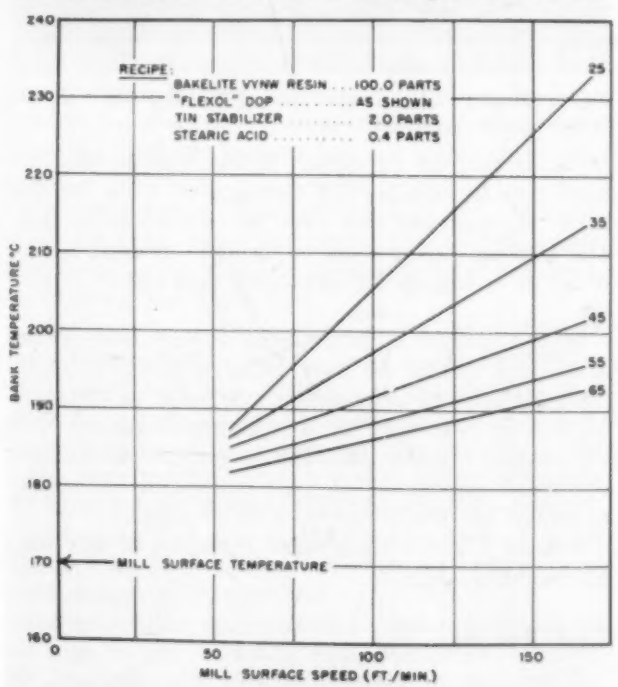

Fig. 1. Effect of mill velocity on bank temperature.

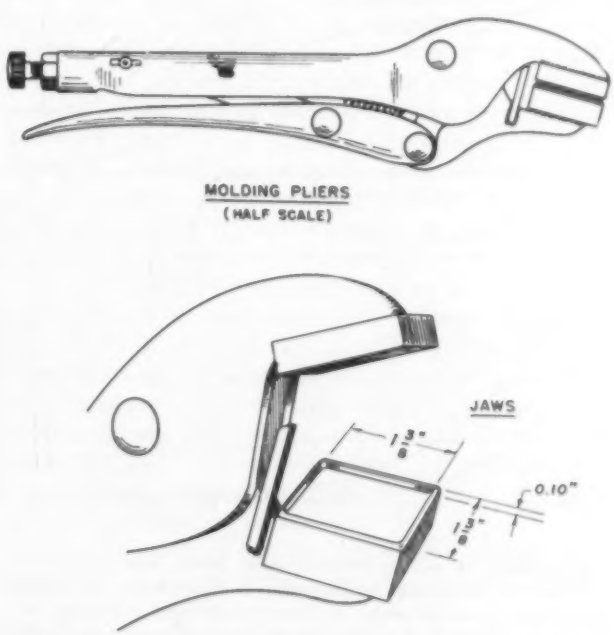

Fig. 2. Molding pliers, showing details of mold cavity.

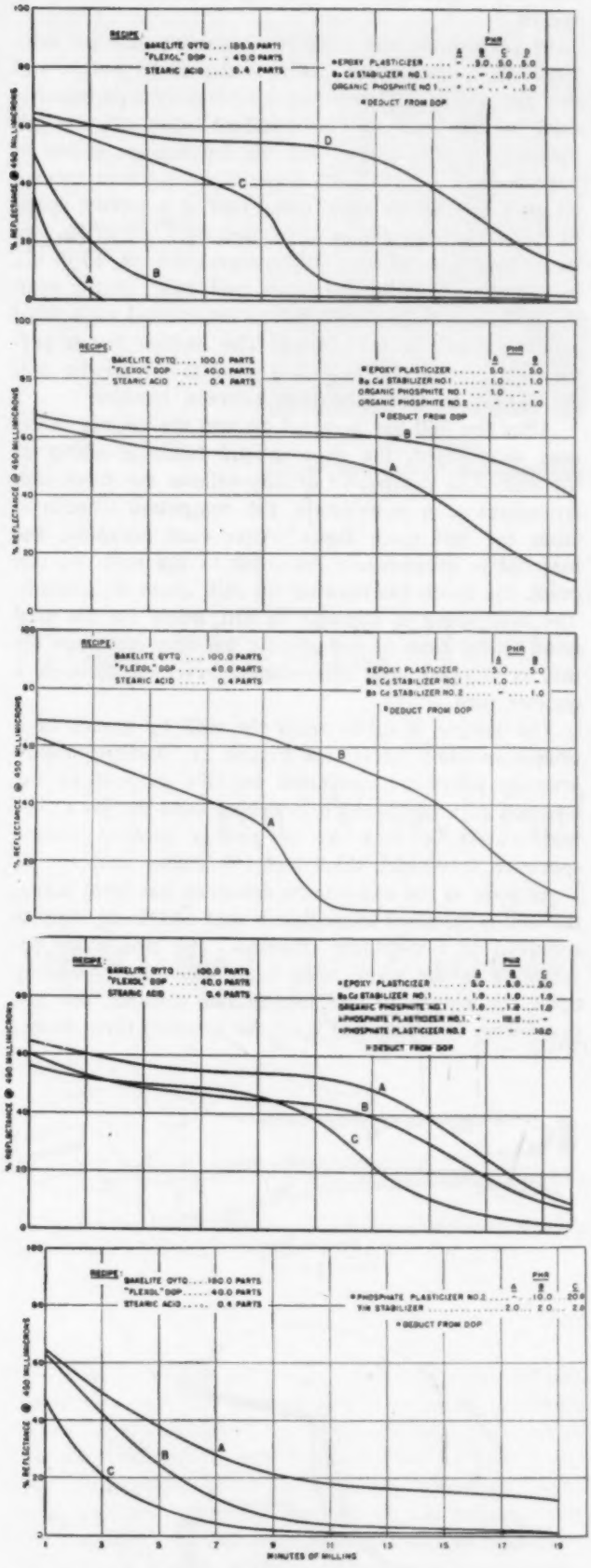
RECIPE:
BAKELITE QYTQ .... 100.0 PARTS
"FLEXOL" DOP .... 40.0 PARTS
STEARIC ACID .... 0.4 PARTS
PHR
A B C D
*EPOXY PLASTICIZER ... 5.0 5.0 5.0
Ba Cd STABILIZER NO.1 ... 1.0 1.0
ORGANIC PHOSPHITE NO.1 ... 1.0
*DEDUCT FROM DOP
% REFLECTANCE @ 450 MILLIMICRONS
MINUTES OF MILLING

Fig. 3. Effect of milling time on color level: (top to bottom) 1—Effect of stablizing components; 2—comparison of organic phosphites; 3—comparison of barium-cadmium stabilizers; 4—Effect of different phosphate plasticizers with cadmium-barium stabilizer; and 5—Effect of phosphate plasticizer used with a tin stabilizer.

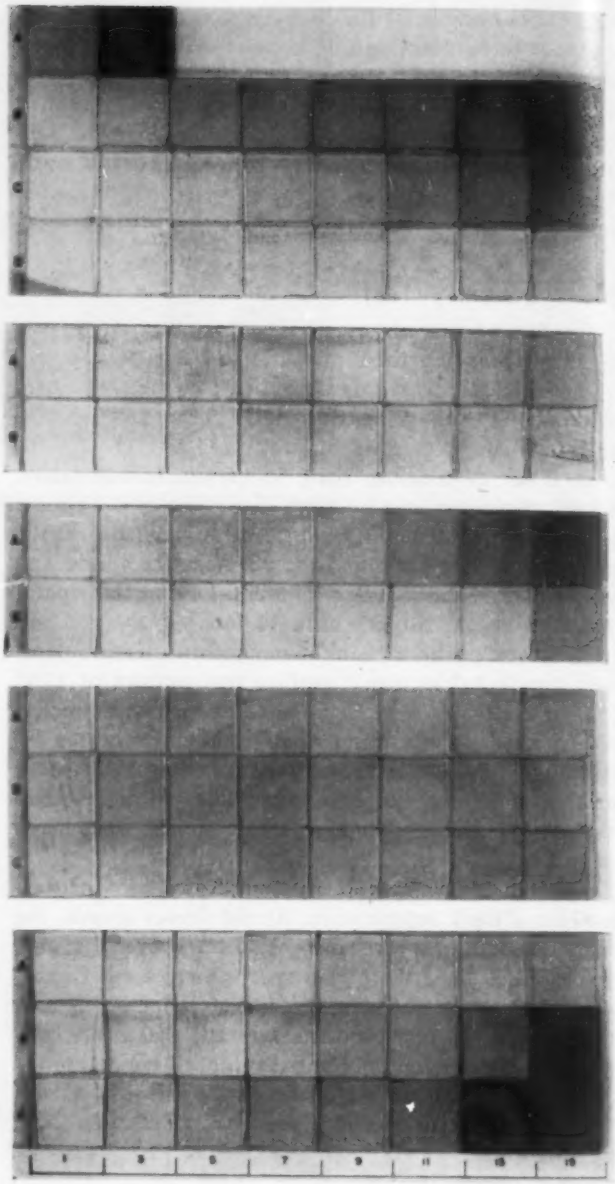

Fig. 4. Samples used to obtain curves of Figures 3-1 to 3-5, shown in corresponding vertical order.

or terminated at an earlier period. During the time lapse between removal of the samples from the mill bank, the operator can trim the individual samples. The trimmed samples can be enclosed in a pre-labeled series of envelopes for convenient and light-free storage.

In the interest of maintaining a permanent record of the test results, we have found it useful to record the color level by determining reflectance at 450 millimicrons of blue light in a spectrophotometer. Such information is highly adaptable to graphic presentation. For visual comparison of color changes, it is advisable to mount the specimens on a white card.

Figures 3 and 4 show some examples of this test's practicability.

Test Results

Figure 3-1 is a graph showing the effects of the

(*Continued on page 286*)

McMahon Studio

MILTON E. ABRAMSON, *Examiner of Trademarks, United States Patent Office, Washington, D. C.*
and
Member of the Bar, District of Columbia

How to Select a Plastics' Brand Name

Major reasons for failures of trademarks to function properly are described, with suggestions for avoiding such failures.

IN terms of age, the plastics industry has just about outgrown its knee breeches, but in size it already is a giant among industries. Plastics have become the base materials in a wide variety of fields. In other areas where the synthetic product has not taken over completely, it has made deep inroads. Versatility, comparative inexpensiveness of the unit product, and resistance of plastics to the elements have enabled new consumer items to appear at costs calculated to increase the standard of living the world over.

Add to these desirable qualities the availability of plastic base materials, and the result is stiff competition among producers and dealers. Competition for consumer favor calls for careful planning and marketing. In our free, competitive economy, the marketing plan of any company must include one or more trademarks which, in turn, the purchasing public must be "educated" to accept. Surveys, such as one recently reported in the "Harvard Business Review," offer strong evidence that people do buy by brand name.

The choice of a trademark, then, becomes one of the first steps in any marketing plan. For obvious reasons, one must exercise great care in its selection. When the mark is finally adopted, a great deal of money is spent to advertise its existence. Bags, invoices, order blanks, and stationery carry its imprint in prominent fashion (see Figures 1 and 3), and it also is used to identify the company's warehouse, plant, and office. The sole message carried on many delivery trucks is the company trademark. In short, a good deal of time, effort, and money is spent to encourage customer acceptance of the new mark; a wise investment when it is considered that the trademark very often is the only way a satisfied customer identifies goods when re-ordering.

On the other hand, the haphazard choice of a trademark can lead to disappointments, if not to actual disaster. The mark can be ineffective in operation, or lost by court order. In either event, the money and time spent in encouraging customer recognition of the mark is irretrievably lost. These disappointments can be largely avoided, and an attempt will be made here to point out some of the dangers which exist and the means for avoiding them

First, let us make sure we know what constitutes a trademark. A trademark is a word or symbol used by

The views expressed in this article are the author's own. Although effort has been made to accurately express the views of the Patent Office, it should be understood that the Patent Office neither approves nor disapproves what is stated here.

Fig. 1. Dow's shipping container for its styrene foam makes use of Styrofoam trademark. STYROFOAM—U. S. Pat. Off. Reg. Nos. 531,823 and 539,147.

a dealer in goods or materials to identify them and distinguish them from those of his competitors. It is not a patent which gives an investor the exclusive right to make, use, and sell an invention, nor is it a copyright which secures to authors, composers, artists, and others the exclusive right to publish and dispose of their works. The trademark is a merchandising short-cut by which a purchaser identifies a product of a particular manufacturer or dealer.

Choosing the Trademark

To a business man, the most important function of a trademark is to distinguish his goods from those of his competitors. Therefore, when you select your mark it must not be confusingly similar to any other mark used in identifying the same or similar kinds of goods.

Fig. 2. Koppers' combines in a single trademark the origin of the product and the impressive difference in volume of unexpanded styrene beads and the foam made from this quantity of beads. KOPPERS—U. S. Pat. Off. Reg. No. 634,263.

If you do choose a mark which is similar or identical to your competitor's mark, it is not only possible that your customers will mistakenly buy your competitor's goods but you also may be sued as an infringer. In addition to a possible award of money damages, your competitor can stop your use of the mark. Adding insult to injury, he also may reap the benefits of your advertising campaign. In selecting your mark, therefore, be sure that it can mean only your goods and no other.

Before you finally decide to adopt a mark, search the recesses of your memory. Did you ever see the mark or anything like it in trade literature or in the advertisements of competitors? Your investigation must include all competing items, though they may not be made from a plastic material. If you do not recollect a mark similar to the one you intend to adopt, the next step is to search the trademark records of the United States Patent Office in Washington. This can be done either personally, or by retaining the services of any experienced trademark attorney to make the search for you. Remember, the law places a burden on you to select a distinctive trademark, or run the risk of a lawsuit for infringement.

Choosing a trademark which is confusingly similar to one used by your competitors is only one of the dangers involved; there are other pitfalls to avoid. For instance, a word which is merely descriptive of plastic, or of your finished or semi-finished product, should not be adopted as the sole or principal feature of your mark. A descriptive word may specify the purpose of a resinous plastic material, such as "Cold Mold," or the purpose of a finished article made from plastic, such as "Cover All." It may describe some characteristic of the plastic or finished item such as "Hi-Temperature" or "Clear Vue."

Similarly caution must be exercised when choosing a mark which is geographically descriptive. Few geographical areas have as yet become so thoroughly identified with the industry that they would be held geographically descriptive. Expert advice should be sought before investing capital to promote such a mark. These descriptive words cannot be exclusively appropriated by any one manufacturer or dealer; however, all such words may be used together with another valid trademark.

Under certain conditions, descriptive words and geographically-descriptive designations can become distinctive of your goods and, as such, will be protected by the courts. The process whereby a trademark becomes distinctive is clothed in legal technicalities, and discussion of this point would be too lengthy for inclusion here. Be mindful; unless you are sure you understand these points of trademark law, you will be wise to secure expert opinion before you adopt such marks.

The plastics industry has displayed a marked tendency to select as trademarks the prefixes and suffixes of chemicals used in plastics production or of their generic designations. These include "Sty" for styrene, "Plasti" for plastic, "Cel" or "Cell" for cellulose or cellulosics, and "Acryl" for acrylic. Other prefixes and suffixes often used are "Poly," "Thene," "Dura," and "Foam." The courts have constantly approved the use of such prefixes and suffixes as parts of arbitrary words and have gra-

tuitously praised the "suggestive" names thus coined as the best kind of mark.

The courts have held, however, that prefixes and suffixes are in the public domain and can be used by any producer or dealer in his trademark provided, of course, that it is not confusingly similar to the mark of a competitor. The courts have been reluctant to prevent a newcomer's use of such prefixes and suffixes unless it was likely to cause considerable confusion among the trade. They do appear to be quite strict with a newcomer whose mark comes close to an older, established trademark which is completely arbitrary. Considerable thought should be given before choosing a mark which "suggests" the chemical constituents of your product or the product itself.

Surnames as trademarks, even one's own surname, offer problems, too. Courts often give limited or no protection in suits for infringement of this kind of mark, on the theory that others also are entitled to use their own names. Yet, some of the most famous American trademarks are surnames! i.e., Johnson's wax Smith Brothers cough drops, and Campbell's soups. These names have become so completely associated with the products they identify, that they have acquired a secondary meaning in commerce; that is, they have become distinctive of the goods to which they are applied. Once a mark has become distinctive, it merits complete protection by the courts. Before you adopt a surname as a trademark, however, be sure you are willing to wait until the name has become so well-known that there can be little doubt that it refers only to your product. Then, you will be able to stop others from using the same name as a trademark; even those whose own surnames are identical to your mark. Of course, you cannot stop anybody from using his similar or identical name in the usual course of business.

The utmost care must be exercised in the selection of a trademark for a newly-discovered product. Very often the inventor or promoter of a new item selects a word or words as a trademark, only to find later that the entire trade has appropriated the notation as a generic designation. Once this has happened, it generally is impossible to recapture the notation as a trademark. Trademarks which were lost to their owners in this way include "cellophane," "linoleum," "escalator," and "aspirin." Money invested to promote such trademarks obviously must be written-off as a loss. A carefully laid plan must be followed to avoid such disappointment.

This plan need not be difficult nor expensive, but does involve a little time and thought. In essence, the plan consists of two steps: (1) give the new product a name; and (2) choose the trademark. Unless you first give the new product a name, you probably will find your trademark slipping away from you and into the realm of a generic designation.

Once a new name has been selected for your new product, it would be wise to publicize it. Such publicity is best secured through articles and advertisements in trade magazines, and reports in technical journals. While the new item is being introduced to the public, your own literature should refer to it by its chosen name. This will prevent unscrupulous firms from appropriating the name before it has become established as a legitimate trademark.

After the product name has been chosen, you must choose your trademark. Care must be taken to avoid all the previously-mentioned pitfalls. Above all, the mark must not confuse the purchaser as to whose goods he is buying. You must not choose a word or words which other producers or dealers have a right to use; you must not use a word which is misleading; and you cannot appropriate the name of the new plant as a trademark, even if you originated that name.

Using the Trademark

In English-speaking countries, a word or symbol cannot be protected as a trademark until it actually has been used as such. Merely intending to use a mark, or using it in a manner which is not recognized as trademark use, gives you no rights that the courts will protect.

The trademark law requires the mark to be used on or in connection with your goods. The mark can be printed or impressed directly onto the goods, or it can be printed on the containers in which the goods are shipped (see Figures 1-3). Your ownership of the mark begins only when you properly use it as a trademark.

A mark used in unconventional ways may or may not

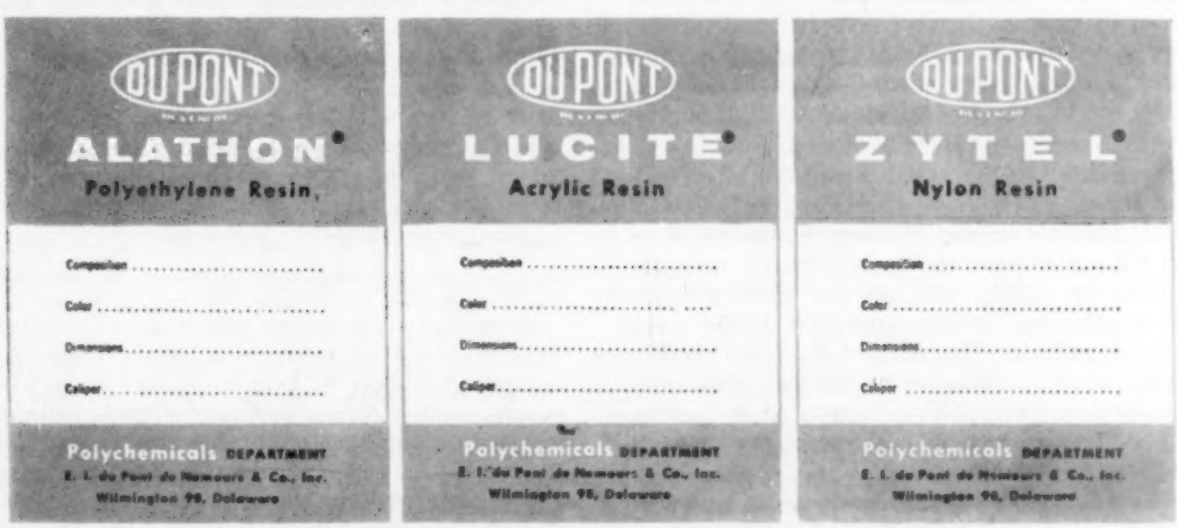

Fig. 3. Du Pont's shipping labels for its plastic materials makeuse of the registered trademarks. ALATHON—U. S. Pat. Off. Reg. No. 543,580. LUCITE—U. S. Pat. Off. Reg. Nos. 601,789 and 611,278. ZYTEL—U. S. Pat. Off. Reg. No. 603,799.

be accepted by the courts as sufficient to establish a trademark right. Use of the mark on trucks and barges should be only a supplementary one. Marking truck sides and tailgates certainly advertises the name, but in at least one court suit, the use of a mark on delivery trucks has been held to be inadequate. Printing the mark on letterheads, order blanks, and invoices, as well as advertising it in newspapers have been definitely rejected as evidence of requisite trademark use. These latter uses will bolster your claim to the mark, but are not considered trademark use by law. The mark must be used physically on or in connection with the product when it is moved in commerce and delivered to the purchaser. It must be affixed so that the purchaser can see it, and it must be presented so that there can be no doubt as to the identity of the goods being purchased.

Finally, the trademark should be registered with the appropriate state agency and, if the mark is to be used in interstate or other commerce controlled by Congress, it should be registered with the United States Patent Office. Benefits received through state registration vary greatly among the states, and should be investigated for the state in which you do business. If your mark qualifies for registration in the Patent Office, you can secure several important benefits under the provisions of the Lanham Act of 1946 which makes the protection of your mark considerably easier.

Practically all large producers and many smaller ones avail themselves of the rights and benefits provided in the Lanham Act. It must be remembered, however, that before a mark is registered in the Patent Office, it is examined much in the same manner that a court would examine it if the validity were challenged. If the mark meets the exacting requirements of the law, it is registered. The courts must accept this registration as evidence of your ownership of the mark and your exclusive right to use the mark in the vast majority of cases. It may even become conclusive evidence of your right to use the mark, and it may thereby become incontestible. Registrants are also entitled to protection against infringement and unfair competition. Registration also can be constructive notice of your ownership of the mark.

The many conditions and dangers involved in the selection of a trademark may seem burdensome, but better to be safe than sorry. Careful consideration of the dangers and "taboos" mentioned throughout this article will result in the selection of a strong and valid trademark to which the courts will give the greatest protection. The good will you strived so hard to build into your mark will pay off when customers confidently order your product by this selfsame designation you chose carefully and developed properly.

—THE END

Heat Stability Test for Vinyl Calendering Compounds
(*Cont'd. from page 282*)

various components in a barium-cadmium-epoxy stabilizer system. The information obtained for this and the following graphs is based on a non-rigid recipe of 100 parts Bakelite QYTQ resin, 40 phr "Flexol" DOP plasticizer, and 0.4 phr stearic acid. The variables in the stabilizer system are shown in the upper right-hand portion of the graph. Color level measured at 450 millimicrons is plotted against milling time. The color plaques of Figure 4-1 are the actual test specimens from which these data were derived.

It can be seen that stability of the base formulation is improved by the addition of the epoxy plasticizer, as shown by cure B. Substantial further improvement may be noted by the inclusion of barium-cadmium stabilizer, as illustrated by curve C. Curve D illustrates the value of an organic phosphite, which improves both color and ultimate stability.

Although the stabilizers and plasticizers have not been identified specifically, they represent products commercially available in the industry. In the graph of Figure 3-1 can be seen the many elements necessary to measure the stability of a product. From the one-minute sample, we have an illustration of the initial color of the material. The slope of the curve displays the ability of the formulation to maintain good color as processing continues. This is referred to as "holding color". The ultimate stability is shown by the approach of the curve to the base line.

Figures 3-2 and 4-2 compare two organic phosphites. Product B, containing a different organic phosphite, has maintained superior color throughout the test.

Figures 3-3 and 4-3 compare two barium-cadmium stabilizers. Mix A contains a barium-cadmium soap in which the barium makes up the greater portion, while B represents one of the high cadmium stabilizers which probably also contains an inhibitor.

The degradation of thermal properties by phosphate plasticizers is well known. In Figures 3-4 and 4-4, this is illustrated by means of the high-speed milling test. Additional examples of the effect of phosphate plasticizers are shown in Figures 3-5 and 4-5. It is observed here, again, that the color is degraded by additional increments of a phosphate plasticizer.

A semi-quantitative estimate of compound lubricity may be ascertained from the time required to obtain a rolling bank on the mill combined with the time of sticking. Compounds will usually give rolling banks before one minute has elapsed. Those compounds which do not give rolling banks generally have excessive lubricity, and will frequently cause calendering difficulties with sheeting where smooth banks are necessary at low shear rates. Compounds which stick in five minutes or less are under-lubricated, and are likely to cause film calendering problems.

Summary and Conclusions

Three years of experience with this test has convinced us of its value in correlation with actual calendering production operations. We have found it to be particularly adapted to development and control work, because the test requires only small amounts of raw materials. Since the over-all test period is generally under 30 minutes, it is possible to selectively determine the proper portion of each component influencing thermal stability.

—THE END

Developments in Plastic Materials—1956

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THE engineering properties of plastics received a great deal of attention in nearly all classes of plastics. Numerous articles discussed the physical properties of plastics at various temperatures. Impact strength, heat distortion resistance, tensile strength, and electrical properties are examples of engineering properties which have been treated in discussions that provide data useful for the design engineer. The major thermoplastic molding powders have been treated.

The appearance of so much excellent and highly useful engineering data has been accompanied by a great deal of eager interest on the part of fabricators and end users to make improved designs for better utilization of plastics. There are few fabricators left in the field who rush blindly into applications, and there are increasing numbers of fabricators who spend a great deal of time engineering new applications in an effort to build their business soundly.

Applications of plastics are broadening in the range and volume. Among the applications which are growing vigorously may be included the ever-increasing use of plastics in the building industry and in furniture applications. Shoe heels have been a notable plastic application because of the large quantity of units which have been manufactured, and because of the lesson taught through the realization of a large potential plastic application which had lain inactive for a long time. More plastic will be used in shoes as polyethylene applications grow in counters, inner soles, and toe caps.

New Materials

The annual crop of new materials which are not available for tests, but only for discussion, was large and interesting. Delrin and Acetyl resins based on formaldehyde were announced by Du Pont. This new plastic has a heat-distortion temperature in the neighborhood of 340° F., low water absorption, high strength, and good light stability. The material was introduced in a fashion calculated to cause the minimum amount of excitement and disturbance among fabricators and end-users. The plastic was introduced as not available for at least two years and, even then, only upon the condition that suitable and sufficient applications could be developed as to warrant its manufacture.

Penton, a thermoplastic polyether with a five-carbon monomer unit, was introduced by Hercules Powder Company. This material is crystalline in nature and has high-chemical resistance, with some exceptions. It has been used for gears, pipe fittings, valves, and other mechanical applications. The crystalline nature of the material causes it to have good rigidity at temperatures approaching its melting point. It also is said to retain its strength well under high temperature and moisture conditions. This material also was introduced conservatively and, along with Delrin, has a chance to grow properly without having excited people rush into poorly-calculated applications.

Stereopolymers received considerable attention although few, if any, samples were available to see and touch. Catalytic polymerization systems have been devised by Dr. Natti and others which can cause polymerization of monomers to take place in established patterns according to the configuration of the molecules. When the molecules are polymerized in parallel arrangements of radicals on one side of the carbon chain, they are termed isotactic. When radical groups are arranged in alternate fashion on opposite sides of the carbon chain, they are called syndotactic. When the units are arranged in heterogenous order, the polymers are called atactic.

Polypropylene is one of the plastics which may be produced with the aid of the new catalysts which can make a wide range of molding compounds.

Thermosetting Materials

Electrical components continue to use phenolic resins in large quantities. Ureas and melamines have grown in healthy fashion through their use in dinnerware. Fabrication technology has received considerable attention in this old field, and it is likely that the thermosetting materials may grow considerably with newer methods and improved techniques of fabrication.

Nylons

Several domestic manufacturers have begun production of Nylon 6 in the United States, and this material shows promise for extrusion and for blown bottles. The material has higher viscosity at fabricating temperatures than Nylon 66, which is traditional as a fiber-forming material. This higher viscosity in the melt phase allows extrusion and blowing. The chemical resistance of Nylon 6 provides promise in bottles and aerosol containers.

Epoxy Resins

The epoxy resins have grown in volume at a rate of increase of approximately 50% per year since 1954. Their value in making metal-working tools has become firmly established, and large quantities of epoxy resins are being used for this purpose. The moisture resistance and weather resistance of epoxy resins makes them good for combination with glass reinforcement to provide extra-duty reinforced laminated plastics.

Glass-Reinforced Plastics

Molding compounds of polystyrene and glass suitable for injection have been announced as adequately available. The short-time heat resistance is high, and physical strength is good.

Glass-polyester materials continue to grow in the applications where toughness is required. Improvements in fabrication methods have been of considerable assistance in assuring dependable physical properties from one piece to another and over long aging periods. Improvements in fabrication also have helped to reduce the costs of fabricated parts. Nylon-glass combinations have been announced by two manufacturers.

Foams

Polystyrene beads which can be foamed-in-place have made gains in applications. This material became available rather soon after its first announcement and reduction to practice, and there has been some lag in picking up applications which will require large volumes of material.

Vinyl foams in the range of seven pounds per cubic foot have appeared and have shown promise of large-volume use which is expected to become larger when five-pound per cubic foot material is available. Urethane foams have found large-volume uses in padding such as automobile crash-pads, carpets, cushion padding, and other furniture upholstering. The foams are a large tonnage potential in the plastics materials field. Already, they have done considerably more than show promise.

Polystyrene

General-purpose polystyrene has found its way in increasing tonnage into the rigid packaging field. Molding techniques and equipment have been improved over the past two or three years to allow faster production of thin-wall containers, and this has brought the cost of such containers to within competitive range of containers made of other traditional materials. Shock-resistant polystyrene materials have continued to add poundage to their use. Vacuum-formed refrigerator parts have appeared in large quantities, and refrigerator inner liners have been made for a few models. When the entire inner liner of the refrigerator is made of plastic, this will increase the use of shock-resistant polystyrenes by a large percentage.

Methylstyrene-styrene copolymers and methylstyrene-acrylonitrile copolymers have been receiving much attention and good notices. The high-heat resistance of these copolymers, plus the chemical resistance of the acrylonitrile copolymer, indicates good potential for future applications. Shock-resistant materials of higher heat resistance and more translucence have begun to appear in the applications field. Thin-wall containers which have shock resistance and transparency are highly desirable and when a material can provide both of these properties, much more rigid packaging will be seen using shock-resistant polystyrene formulations.

Cellulosics

Modern molding methods have helped considerably in providing molded articles of improved dimensional stability in the cellulosic field. Products which need the excellent physical properties of some of the more expensive cellulosic materials have been made and found acceptable in spite of the higher cost of the material. This is partly due to a change of attitude on the part of end users with respect to cellulosic materials, and partly to improved fabrication methods and greater knowledge in this field.

Higher-acetyl cellulose acetate has reappeared. Cellulose propionate has been employed to make a transistor radio cabinet. A lubricated ethylcellulose formulation has been used in rollers for sliding doors, among other self-lubricating applications.

Polyethylene

Polyethylene has grown to a production of nearly 50,000,000 pounds per month and usage is near this figure. This does not include very much of the new high-density linear polyethylenes, although they are growing rapidly as production facilities become available. A range of densities appears to be the pattern for polyethylene formulations. The high-pressure polyethylene has the lowest density of approximately 0.92. Intermediate density materials are appearing between the low-density, high-pressure material and the high-density catalytic linear polyethylene.

Experience with all grades of density is beginning to show engineering information which will be of assistance in design. Cold bending tests, for example, indicate extremely low brittle points for all densities, but higher density materials show considerable sensitivity to speed of impact, especially at low temperatures, and the brittleness appears at temperatures considerably higher than the —70° F. generally quoted for polyethylene.

Many kinds of polyethylene film can be produced in a range of stiffness, transparency, slip printability and gloss. Inherent properties of the plastic indicate that it may not be possible to have water whiteness, complete lack of blocking on rolls, printability, and gloss all combined in one film. Improvements in the appearance of polyethylene films, however, is very likely to occur because of the intense development and research taking place in this field.

Polyethylene pipe is here to stay, despite some of its previous and present difficulties and misapplications. There is a good attitude on the part of most fabricators and producers toward the production of highest quality, thoroughly-stabilized polyethylene pipe.

—THE END

Can We Package Color?

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COLOR has been an attraction to man through the ages. For example, Sir Isaac Newton discovered that one of man's guiding lights, "The Sun", was composed basically of an array of different colors: red, orange, yellow, green, blue, indigo, and violet. The ancient orientals, we are told, had colors which modern man has never matched. The early artists of some of the world's greatest artcrafts depended on color to convey their thoughts or visions to the public which, in turn, has observed these artistic treasures through the ages.

Physicists, chemists, and other scientists greatly antedate our age of color study. Two segments of the chemical industry have contributed greatly to every household: the dye and color chemists, and the fabrics chemists. It is through the work of these men of science that we are able to have a color-stable rose/beige nylon rug on our floor, orchid Dacron sweaters for the ladies of the family, and a rayon-nylon-cotton blend of chartreuse upholstery in the new family car.

What bearing has the above on the technology of the plastics industry? Exactly none, if it cannot be used.

In the field of plastics, a rapidly expanding process is the extrusion of thin gauge plastic films. This process is used at Clopay to produce Clopane clear vinyl film for packaging and other utility uses requiring clarity. Also produced by this process are films from the new high-and-medium density, boilable polyethylenes. Other types of polyethylene films, ranging from the highest clarity and slip to the lower clarity utility grades, are produced by extrusion in our new plant at Augusta, Ky. Aspects of these and other packaging films are discussed with relation to their use in color packaging.

Man is an ingenious individual as well as a curious one. He has learned through the passing of time to be a salesman as well as an artisan. As a salesman, he has determined that "the neater the bundle, the better it sells". The more colorful it is, the more it attracts the human eye. For proof of this we have only to compare the family car of today with its counterparts of the mid thirties.

Man has developed a number of materials in which to pack highly useful and highly colored items to make them more appealing to the buyer's eye. Included in these packaging materials are many plastics. Such materials are clear vinyl films, polyethylene, Mylar, cellophane, cellulose acetate, styrene, cellulose acetate, butyrate, acrylates, Saran, and possibly several others have been utilized through the skill of packaging engineers.

These men must create neat, appealing packages that perform as silent salesmen. To do this, these engineers must resort to their training and knowledge of physical properties of many plastics and other packaging materials. If the engineer studied the advertising literature of some manufacturers, he could easily be led to believe that one of these plastic materials is the panacea of, or the supersalesman for, the packaging industry.

Sometimes in a single advertisement you may find that polyethylene has been used for everything from a potato bag to a drum liner, and along the way, some colorful items such as shirts and socks, packaged in the material. It unquestionably can be used for packaging these products. It has attained a very fine and high place in the packaging field. Polyethylene does have disadvantages which should be weighed by the packaging engineer in certain markets, especially where color is a factor.

On a recent visit to a supermarket, I saw a clerk wrapping head lettuce in cellophane. Being curious and knowing that this particular market consumed large

amounts of polyethylene, I asked a simple but obvious question: "Why do you wrap head lettuce in cellophane in place of putting it in a polyethylene bag?" In a rather quick comeback, the clerk replied, "The lettuce doesn't look as green in polyethylene."

In shopping during the recent holidays, I observed many interesting and spectacular packages of various types. In the department stores there was displayed an array of merchandise, much of it shown in various types of plastic films. Obviously, some had "Polyethylene Haze" in place of "Vinyl Sparkle" normally associated with extruded clear vinyl films. Various types of plastic films and packages could be recognized easily. Many of the packages did a terrific job in portraying the actual color and color depth of the contents as the packaging engineer had planned.

The polyethylene industry is young, but has made great strides in the packaging industry where many excellent applications have been established. It is very questionable, however, if any polyethylene on the market today can portray color depth as well as do vinyl, Mylar, cellophane, and cellulose acetate films.

Clear vinyl films have much to offer the packaging engineer for displayability, color portrayal, shelf life, sales appeal for impulse purchases, merchandise sparkle, cost, printability, handling, and other items associated with the sale and packaging of merchandise. Vinyl technology is very broad today. The vinyl resin chemists have done an excellent job in giving us a broad range of resins from which to choose. The plasticizer chemists have built a range of plasticizers that will give a wide variety of properties. The stabilizer chemists have studied the problems associated with heat and light stability of vinyl resins. They, too, have much to offer the formulator to build a modern packaging film that will give excellent properties for items to be packaged.

A local paper has a column advising home owners on their problems. On a recent day, a question was published asking about the advisability and efficiency of using plastic sheets or films for storm windows. In reply, the editor of this column said, in part, "The plastic is not completely transparent, and looking through it gives the impression of being in a mild London Fog".

Don't let the spectrum surrounding your merchandising and packaging program get lost in a fog. Competition might discover the broad aspect of the sun's spectrum and get into the light while a shroud of fog still surrounds your articles of color, utility, and necessity.

The properties of clear vinyl films are such that by their greater utilization, the packaging industry, like Sir Isaac Newton, may discover a broader spectrum in color merchandising. If given consideration, it may be found that this broadened spectrum is a sun with a new horizon bearing new color in packaging merchandise—the many-colored fruit of man's labor.

—THE END

Color Variations in Coatings for Plastics

(*Continued from page 279*)

painted in light colors. If the problem is caused by a back-up coat bleeding to an undercoat in the case of second surface, or from a primer to a top coat in the case of first surface, the paint manufacturer usually can furnish paints made from non-bleeding materials. Low molecular-weight organic pigments and solvent-soluble dyes often are bad bleeders, and should be used with caution. If the cause of bleeding is in the molded part itself, a coat of black paint may be applied which often will prevent the bleeding, and the parts may then be painted in whites or pastels.

Etching

Solvent-etching of the plastic by the finish usually will show up as spotty or irregular color or roughened areas over the part. Etching often has a tendency to follow strain lines where solvents are likely to attack. In the case of vacuum metallizing, the slightest blemish on a plated surface detracts from its appearance. Etching of the base coat by the back-up must be avoided, and is important in both first- and second-surface decorating. Severe etching often is accompanied by a color change. Pigmented metallics which have severely etched the surface will look darker than normal when viewed through the plastic, and more nearly like aluminum when viewed on the surface.

Etching may be reduced or eliminated by the addition of less active thinners. These inactive solvents must be added with care to avoid throwing resins out of solution which will result in a solvent blush looking similar to humidity blusy.

Lights Used to Check Color

Many companies have a preference for using north daylight to match their colors because it is a uniform system available to all. Standard artificial light is available from a number of sources, including the MacBeth booth. Production colors usually are checked under the commercial fluorescent lamps used in the plant.

Two colors matched with different pigments may look exactly alike under a standard north light, but

(*Continued on page 299*)

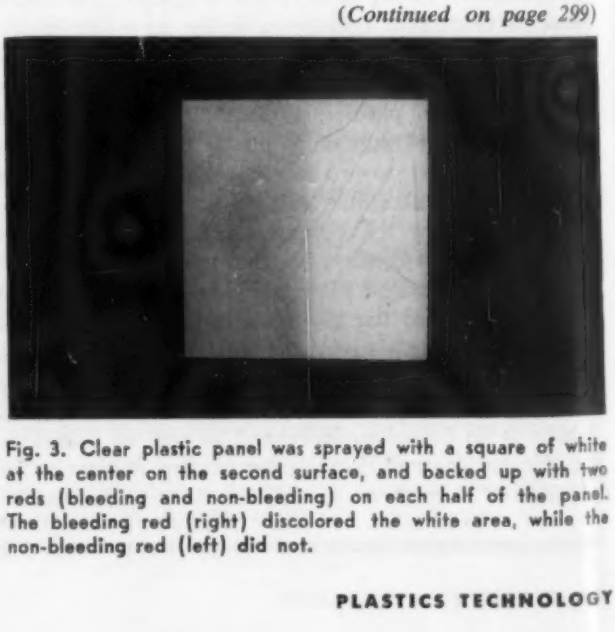

Fig. 3. Clear plastic panel was sprayed with a square of white at the center on the second surface, and backed up with two reds (bleeding and non-bleeding) on each half of the panel. The bleeding red (right) discolored the white area, while the non-bleeding red (left) did not.

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Heat-Distortion Properties of Polysulfide Polymer-Modified Epoxy Resins

Results of a detailed investigation of HDT properties of both modified and unmodified epoxy resins.

WITH the advent of the era of super-speeds and super-altitudes, increasing emphasis is being placed on the elevated-temperature properties of materials. Plastics, in particular, are subject to deformation at high temperature, and their increasing use in many critical applications makes it desirable to know and control their properties under elevated-temperature conditions. A test had been devised (1,2)* which indicates the relative softening temperature of plastic materials under a set of arbitrarily determined test conditions. This test is excellent for obtaining useful comparative data on the thermal stability of plastic materials (3,4). However, recorded heat distortion data show considerable divergence and lack of uniformity (5). A number of investigators have modified their test equipment (4,5,6,7) and method of correlating the test data (3,8,9) in order to obtain more meaningful results.

Only a limited amount of heat distortion data conocncerning epoxy resins may be found in the literature (10-15) and data for the modified-epoxy resins is even scarcer (10,16-18).

Dearborn and co-workers (11) in their studies found that linear structures resulting from the homo-condensation of glycidyl ethers have low yield points. It is, thus, natural to expect that epoxy resins modified by co-reaction with linear polysulfide polymers would have heat distortion temperatures which would be lower than that of the unmodified epoxy resin. However, this modification results in a system which is considerably more flexible than the original and the problem becomes one of balancing flexibility against reduced HDT (16).

Based on a paper presented before the Division of Paint, Plastics, and Printing Ink Chemistry, American Chemical Society, Atlantic City, N. J. Sept. 18, 1956.

*Numbers in parentheses refer to bibliography at end of article.

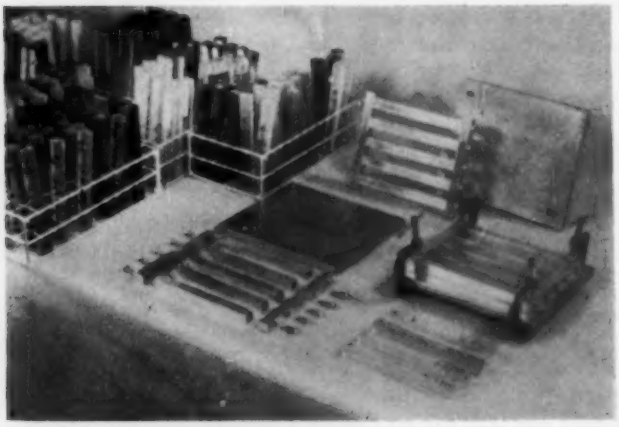

Fig. 1. Specimen molds and storage racks.

Test Procedure

The Heat Distortion Temperature test for plastics has been defined in detail elsewhere (1,2). Briefly, it consists of determining the temperature at which an arbitrary deformation of 10 mils (0.010-inch) occurs on a centrally-loaded beam sample under an arbitrary set of test conditions. The standard tests are run at maximum fiber stresses of 264 and 66 psi. All tests are run in duplicate.

The specimen supports are spaced four inches apart and the load is applied midway between these supports. All surfaces which are in contact with the sample are rounded to ⅛-inch radii.

The sample is placed in the test unit and the unit is lowered into a mineral oil bath which is maintained at 23±1.1° C. for five minutes while the calculated load is placed on the sample. This period should normally be sufficient to allow for creep exhibited by some materials at room temperature. The deflection meter is then set at zero, and the bath control adjusted to give a constant temperature rate rise of 2±0.2° C. per minute.

The test data are plotted as deflection versus temperature, and the temperature corresponding to a 10-mil deflection is arbitrarily defined as the heat distortion temperature (HDT).

Sample Preparation

Our test specimens were prepared by casting the liquid resins in multi-cavity collapsible molds, as shown in Figure 1. Each cavity is 0.5-inch by 0.5-inch and five inches long. Any dimensional changes in the sample on curing and/or aging are taken into account by gauging the samples just prior to test and adjusting the load accordingly.

Several investigators prefer to cast their samples in vertical molds or to machine them from cast molded blocks. In any case, the relative results should be the same.

The cured specimens are removed from the molds and stored in special wire racks (Figure 1) which permit free air circulation around the samples.

The method of conditioning the test specimens prior to test has a marked effect on the test results (3,4,19,20). ASTM conditioning procedures are specified in D618. The best conditioning procedure should be determined for each material early in the investigation.

Our samples were conditioned for a minimum of 30 days at 78±4° F. and 35±15% relative humidity prior to test. Generally, the conditioning time was considerably longer. The effect of aging time on the test results will be discussed subsequently.

Apparatus

The test equipment used in this investigation was designed in our laboratories and was based upon some original ideas suggested by the Shell Chemical Co. Figure 2 shows an individual test unit and Figure IV shows an over-all view of four test units in the bath. In designing this equipment, an attempt was made to have it as versatile as possible and still satisfy all of the requirements set forth in the test procedures.

Referring to the letters in Figure 2, a test unit consists essentially of a lever arm (A), having a weight cup (B) at the front end and counterbalanced by the lead-shot filled cup (C) in the rear so that it placed no load on the test specimen. This lever arm rides on ball bearings on a shaft (D). The load discs (E) ride on a crossbar (F) which transmits the load to the sample via shaft (G) and load plate (H). Also mounted on the crossbar is an Ames micrometer dial indicator (J) in which the spring has been removed so that no correction for the spring loading on the sample is required.

A shaft and piston also is attached to the crossbar which rides with a 1/16-inch clearance in a dashpot (K) filled with steam pump oil. This prevents damage to the equipment if the sample should break, and prevents

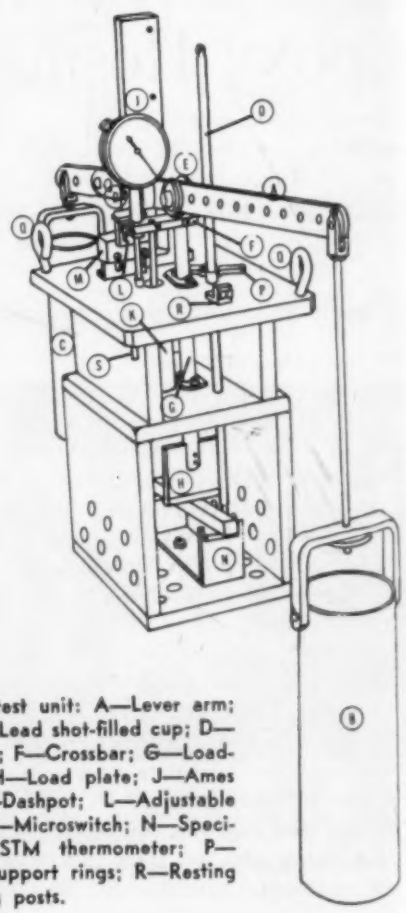

Fig. 2. Diagram of test unit: A—Lever arm; B—Weight cup; C—Lead shot-filled cup; D—Shaft; E—Load discs; F—Crossbar; G—Load-transmitting shaft; H—Load plate; J—Ames dial indicator; K—Dashpot; L—Adjustable arm on crossbar; M—Microswitch; N—Specimen saddle; O—ASTM thermometer; P—Locking lever; Q—Support rings; R—Resting block; S—Positioning posts.

sudden impact loading of the test specimen. An adjustable arm (L) attached to the crossbar contacts a microswitch (M) at the rear of the unit and shuts off a lapsed-time meter when the test sample has reached a pre-set deflection. At the same time a red warning lamp is turned on. The specimen is supported on a saddle (N). Several different saddles are available with different spacings, as well as an individual bath to surround the saddle so that the effects of liquid media other than the main bath oil may be evaluated.

An ASTM calibrated thermometer (O) with an extra long stem, is suspended adjacent to the test specimen. A locking lever (P), support rings (Q), resting block (R), and positioning posts (S) are incidental to the operation of the unit.

The bath itself contains an external heat exchanger with a distributor which forces the oil through the test specimen chamber and back to the heat exchangers by means of a positive displacement pump. This bath is thermostatically controlled to operate at constant temperature, or the temperature may be raised at a constant rate, variable over a wide range.

Calibrated chrome-steel ball and roller bearings are used in place of weights for loading the specimen. This permits tests other than heat distortion tests to be run. For example, where the effects of a constant rate of change in loading on the sample desired at constant temperature, the balls may be dropped at a uniform rate into the weight cans.

The lever arm gives a mechanical advantage which, when combined with the large weight cup, make available extremely high fiber stresses for the testing of laminates or for creep tests. The saddles are high enough to allow for large deflections of the test samples.

With the assistance of the Shell Chemical Co., we calibrated our equipment against commercial heat distortion equipment. Four identical samples were prepared and conditioned for one month. The samples were then stored in sealed test tubes, and two were sent to Shell for test while two were retained in our laboratory. The tests were run almost simultaneously in both laboratories. The test specimens had the following formulation, which lists parts by weight:

Polysulfide liquid polymer LP-3 (Thiokol Chemical Corp.)	30
Epoxy resin, Epon 828 (Shell Chemical Co.)	100
Amine hardener, DMP-30 (Rohm & Haas)	10

The test results are shown in Table 1.

Table 1. Results of Heat Distortion Test Calibration (Test No. 118, Sample B-69827JK)

	Thiokol Unit		Commercial Unit	
	A1	A2	A3	A4
Heat Distortion Temp., °C.	66.0	67.0	67.0	65.6
Average, °C.	66.5±0.5		66.3±0.7	

In order to ascertain the effects of thermal expansion of the test unit itself on the results, test were run in which the specimens were replaced by Pyrex brand glass rod which has an extremely low coefficient of thermal

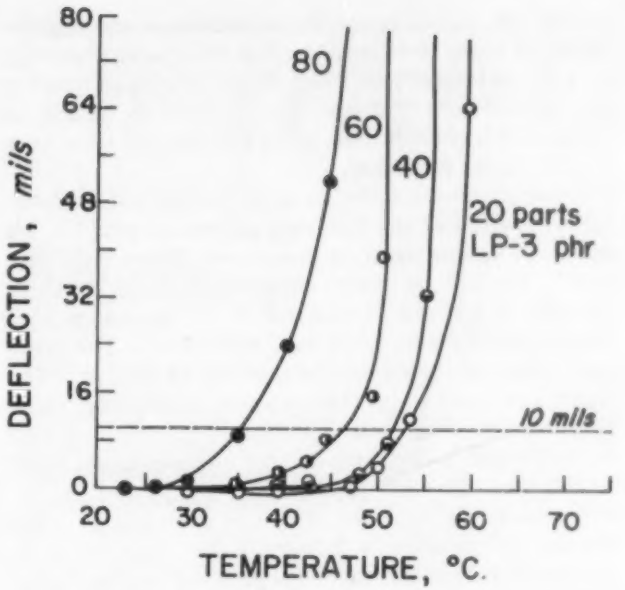

Fig. 3. Typical heat distortion curves for polysulfide polymer-modified epoxy resin.

expansion (1.8 x 10^{-6} per ° F. between 66 and 660° F.). The test was run to 300° F. At this temperature, the net expansion of the test unit components was less than one mil. Although admittedly an error is thus introduced, it is small enough to be insignificant at the test temperatures normally encountered in this investigation.

Lubin (7), DiLiberti and co-workers (6), and Sauer and co-workers (5) have modified their equipment rather cleverly to compensate for thermal expansion of the test specimens. Frequently, Invar has been used to construct the test units to compensate for the thermal expansion of the units themselves; however, this is a rather expensive metal. Cleerman and co-workers (3) have obtained negative deflections near the beginning of the test, indicating thermal expansions of their test speciemsn. We have ob-

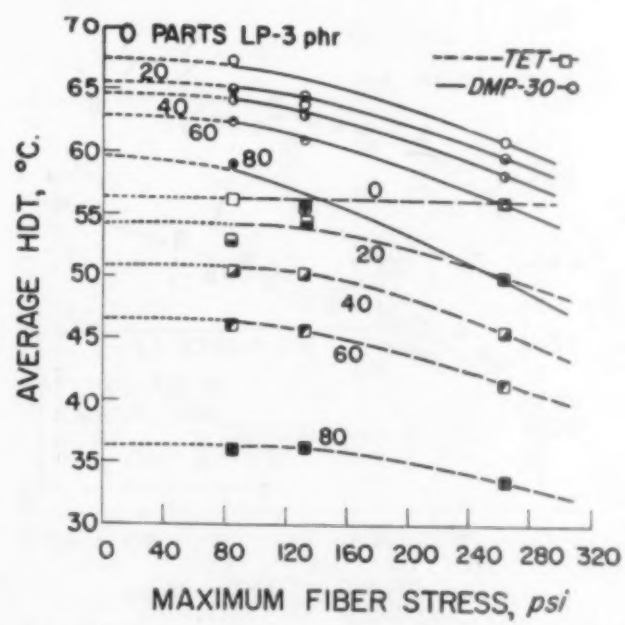

Fig. 4. Effect of fiber stress on the HDT of LP-3 modified Epon 828 epoxy resin.

served the same result with unmodified or slightly-modified epoxy resin samples. The effect is small enough to have an insignificant effect on the heat distortion test results, and we felt that it was desirable to be able to measure this phenomenon, since this thermal effect contributes to the distortion.

Other preliminary studies were carried out to determine the effect of the bath medium on the samples. We use C. P. light mineral oil in our unit. Creep tests were run in the unit at room temperature using duplicate samples in air and in mineral oil at maximum fiber stresses of 264 and 1,056 psi., respectively. The creep rates after 65 hours in the two media differed. The amount of creep which takes place in 30 minutes (which is the approximate time required to complete a heat distortion test) is negligible and has an insignificant effect on the heat distortion results.

As the flexibility of the sample is increased, or when the test temperature is increased, the creep rates are increased and the difference between the two media becomes more pronounced. It is this effect due to increased flexibility and increased creep with increasing temperature that we are essentially measuring when we run heat distortion tests. A number of authors (9, 20-22) have excellent discussions on the time- and temperature-dependent modulus concept for plastics, therefore, this concept will not be covered here.

Several authors have attempted to correlate heat distortion with second-order transition temperatures with little success (23). Since the heat distortion temperature is a rather arbitrary measurement whereas second-order transition is a fundamental property for a given material, a simple correlation would not be expected. On the other hand, if one were to plot the heat distortion data as log of deflection versus log of the absolute temperature according to the method of Moody and Goldbl. n (8), the discontinuity obtained with certain systems should correspond to the second-order transition temperature.

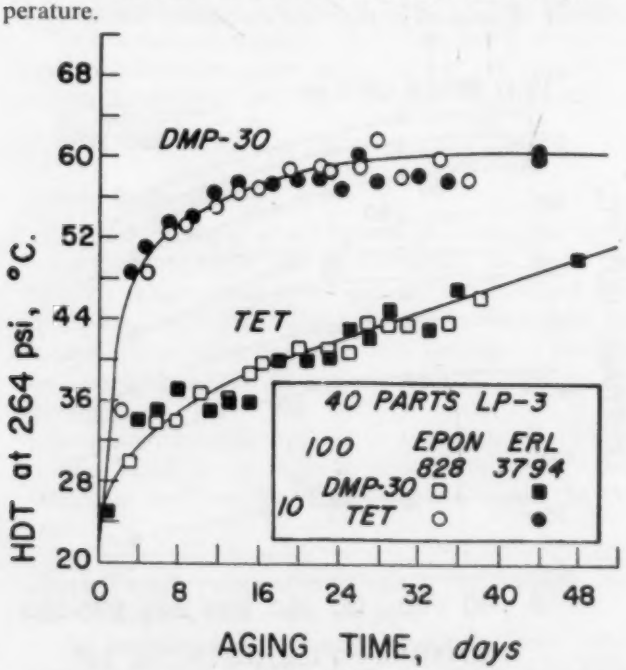

Fig. 5. Effect of room-temperature aging on HDT of LP-3/epoxy resin systems.

We ran dilatometric second-order transition measurements on experimental polyester-modified epoxy resin systems, but found no correlation. Pehaps the effect of load on the heat distortion results is the cause of this disagreement. Boyer and Spencer (24) discuss the shift of the second-order transition temperature with applied force. The relationship is not necessarily linear and depends on the system. If both measurements were reduced to their unstressed conditions, then a good correlation should exist between them. We didn't pursue this avenue of investigation further.

The method of presentation of heat distortion data is important. To report merely the heat distortion temperature at the fiber stress of the test tells very little about the compound. The standard test method recommends that the HDT be reported at two fiber stresses (264 and 66 psi.). This indicates the shift in HDT obtained under reduced loading. In all cases, the HDT would be expected to increase under reduced loading. More important than this, we feel, is the incipient HDT, or the temperature at which any distortion is first observable. Furthermore, the rate of deflection and the shape of the deflection-temperature curve is highly significant (25). The shape of the curve may indicate whether a material is thermoset or thermoplastic. This will be discussed below. Mechlore (26) and Strain (27) report the amount of distortion of different materials at a given temperature.

Moody and Goldblum (8) report their data as log of deflection versus log of the absolute temperature. This yields straight line plots usually having a point of inflection which they relate to a second-order transition temperature between glassy- and plastic-flow regions under the stress conditions of the test. They attempt to relate the shape of the heat distortion curve to parameters which could be related to known physical constants of the plastic materials under test. The equation arrived at was

$$F = KT^m$$

where F is the deflection in mils, T is the absolute temp-

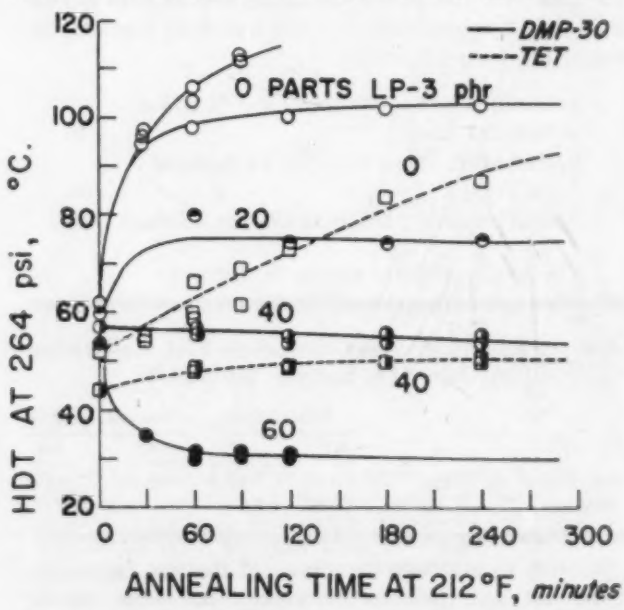

Fig. 6. Effect of annealing time at 212° F. on HDT of LP-3/epoxy resin systems.

erature in degrees Kelvin, and K and m are arbitrary parameters. Nutting (9) derives an equation even broader in scope:

$$F = At^n p^m T^r$$

where A, n, m, and r are constants, t is time, p is pressure, and F and T are as previously defined. Neglecting the effects of pressure and time, which in these tests would be small, this equation would reduce to that of Moody and Goldblum.

The purpose of our investigation was twofold: to determine the effect of variables on the heat distortion temperature, and finding a polysulfide liquid polymer-modified epoxy resin system that would have the highest heat distortion temperature for a given amount of flexibilization.

Effect of Epoxy Resin

One of our first studies was to determine whether the choice of commercially available liquid epoxy resins had a significant effect on the results. The following undiluted resins were evaluated:

Resin	Manufacturer
Epon 828	Shell Chemical Co.
ERL 3794 (BR-18794)	Bakelite Co.
Araldite 6020 (CN)503	Ciba Co., Inc.
Epiphen ER 823	Borden Co.

These resins were cured with 10 PHR of either 2,4,6-tri (dimethyl amino methyl) phenol (DMP-30) or triethylene tetramine (TET) at room temperature. Duplicate samples were tested at 264 psi. after 50 days aging. The average results are shown in Table 2.

These data indicated that TET cures are generally poorer than DMP-30 cures, and show only slight differences with the different epoxy resins. The DMP-30 cures, on the other hand, emphasized the differences between the resins. Because the best result was obtained with Epon 828, it was decided to use this resin throughout the remainder of the investigation. Although we were aware of the considerably higher heat distortion temperatures that may be obtained with unmodified epoxy resins using chlorendic anhydride, pyromellitic dianhydride, and other curing agents (12, 13), these cures, when the epoxy resin is modified with polysulfide liquid polymer, in most cases, become inferior.

Table 2. Heat Distortion Temperatures, °C., of Commercial Epoxy Resins at 264 Psi. Maximum Fiber Stress

	Curing Agent	
	DMP-30	TET
Epon 828	64.0	55.0
ERL 3794 (BR-18794)	63.9	52.2
Araldite 6020 (CN-503)	55.0	54.9
Epiphen ER 823	51.8	56.4

In addition to the liquid epoxy resins, an evaluation of a 50:50 blend of liquid epoxy resin Epon 828 and solid resin Epon 1001 were studied. Although these mixtures were liquid when combined, the viscosity was rather high. Cures were carried out at 250 F. Another approach was to add a reactive diluent, allyl glycidyl ether, to lower the viscosity. In this latter case, room-temperature cures were used. The average results are shown in Tables III and IV.

Thus, there seems to be an improvement in HDT if solid epoxy resin is substituted for some of the liquid epoxy. The use of reactive diluents of the allyl glycidyl ether type also gives some improvement, unless the liquid polymer concentration is high, in which case the HDT begins to drop off.

The amount of LP-3 used in this study is very much higher than that used in the bulk of the heat distortion tests and this, in reality, is a rather large improvement is HDT.

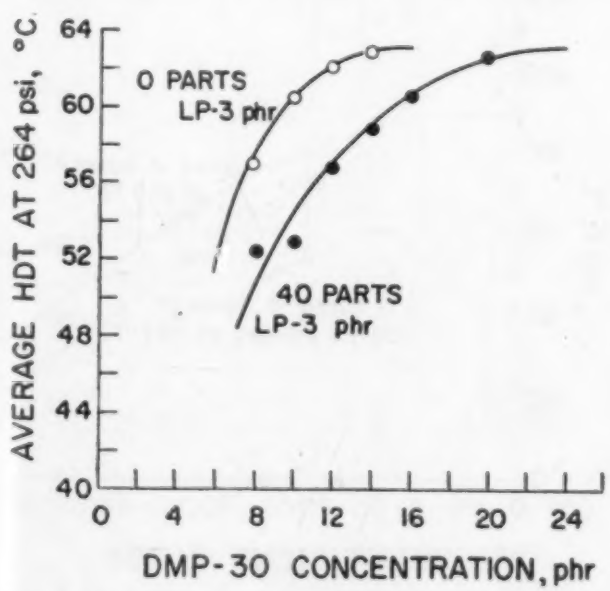

Fig. 7. Log-log plot of annealing time vs. HDT of LP-3/epoxy resin systems.

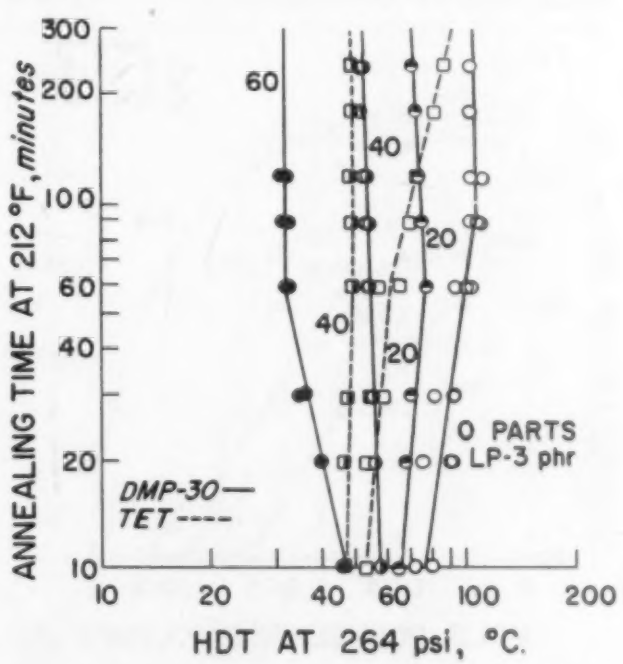

Fig. 8. Effect of DMP-30 curing agent concentration on HDT of modified and unmodified epoxy resin systems.

Table 3. Average Heat Distortion Temperatures of Liquid/Solid Epoxy Resins at 264 Psi.*

Parts LP-3**	0	25	50	75
Average HDT, °C.	71.5	70.6	64.0	41.9

*DMP-30 Cures (10 PHR) at 250° F.
**Per 100 parts 50/50 liquid/solid epoxy blend, using Epon 829 and Epon 1001.

Modified Epoxy Resins

The addition of flexibilizing materials to epoxy resins results in lower heat distortion temperatures. This is true for such modifiers as the polysulfide liquid polymers (16), the polyamide resins (17), and polyester modifiers (18).

Typical heat distortion curves are shown in Figure 3, with parts by weight of polysulfide liquid polymer per 100 parts of Epon 828 as the parameter. All samples were cured with DMP-30 (10 PHR based on epoxy resin) at room temperature and tested at 132 psi. fiber stress. The difference between incipient heat distortion temperature and standard heat distortion temperature varies with the flexibilizer concentration: the greater the amount of flexibilizer, the larger this gap becomes.

Fiber Stress

In Figure 4, the average heat distortion temperature is plotted as a function of maximum applied fiber stress for both DMP-30 and TET cures, with parts by weight of polysulfide liquid polymer LP-3 per 100 parts of epoxy resin Epon 828 as the parameter. These curves are extrapolated to zero fiber stress. (This does not take into account the weight of the specimen itself, which would have the effect of applying a small, but measurable, fiber stress to itself. However, it is obvious from the data that the effect is negligible with these particular compounds, especially since the heat transfer medium has a buoyant effect on the sample.)

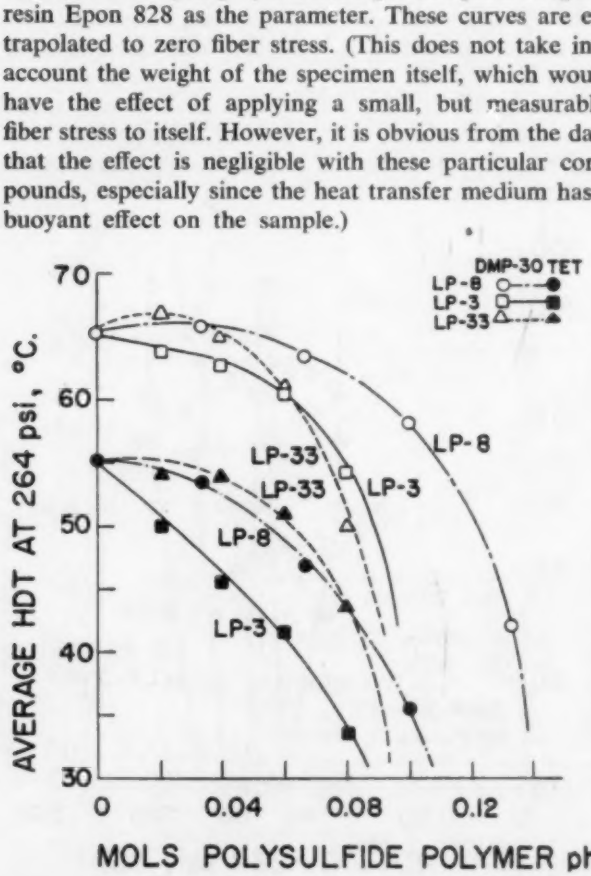

Fig. 9. Effect of flexibilizer (polysulfidepolymer) content and cross-linking on HDT.

Table 4. Average Heat Distortion Temperatures of Allyl Glycidyl Ether/Liquid/Solid Epoxy Resins at 264 Psi.*

Parts LP-3**	0	0	33	33	33	100	100	100
Parts AGE#	0	15	5	10	15	5	10	15
Average HDT, °C.	63.0	64.4	60.8	60.8	61.3	41.2	39.0	36.4

*DMP-30 cures (10 PHR) at 77° F.
**Per 100 parts 50/50 liquid/solid epoxy blend using Epon 828 and Epon 1001.
#Allyl glycidyl ether.

The data in Figure 4 indicate that the change in heat distortion temperature with changes in fiber stress below 34 psi. is very small. It also appears that with DMP-30 cures, 20 parts of LP-3 give a higher HDT than when no LP-3 is present at all. This was not an isolated case, but was indicated in several tests. This corresponds with a balance of other physical, chemical, and mechanical properties of the LP-3/epoxy resin system (16).

Aging and Annealing

In order to determine the effects of aging time on the HDT, a large number of identical samples were prepared and tested over a 50-day period. Both Epon 828 and ERL 3794 resins were evaluated with 40 parts of polysulfide liquid polymer LP-3, and 10 parts of either DMP-30 or TET curing agents, both on 100 parts of epoxy resin.

These data are plotted in Figure 5 for a fiber stress of 264 psi. Even after 50 days of room temperature aging, the HDT continues to increase, although at a slower rate. Here, again, the closeness of results between the epoxy resins is apparent. Cleereman and coworkers (3) conclude that for polystyrene an infinitely long time would be required for a sample to reach its maximum HDT with room-temperature aging.

Annealing (post-curing at elevated temperature) of

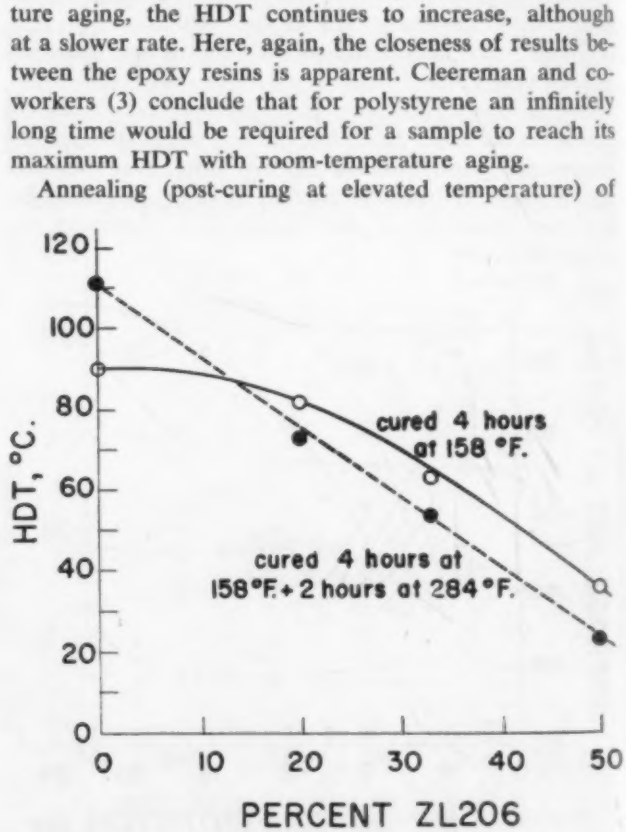

Fig. 10. Change in HDT with ZL-206 concentration at different cure conditions.

LP-3/epoxy resin systems results in heat distortion temperatures considerably different than those obtained with room temperature aging. Both time and temperature exert effects. In Figure 6, the effect of annealing time at 212° F. is shown for various ratios of LP-3 to epoxy resin. It appears that annealing at this temperature for longer than 60 or 90 minutes causes no further change in the heat distortion temperature. It also is apparent that with less than 40 parts of LP-3 per 100 parts of epoxy resin the HDT increases with annealing; with 40 parts of LP-3 it remains almost constant; and with more than 40 parts, the HDT decreases.

These effects become more vivid when the data are presented in a log-log plot (Figure 7) where the optimum annealing time occurs at the point at which the slopes of the lines change. These data are plotted with the scales reversed to correspond with that of Cleereman and co-workers, except that they obtain straight lines when the HDT scale was linear: i. e., their data related annealing time, t, to the heat distortion temperature, T, by the equation:

$$t = Ae^{BT}$$

On the other hand, our data is described by the relation:

$$t = DT^{C}$$

In these equations, A, B, C, and D are empirical constants.

Curing Agent Concentrations

The DMP-30 curing agent concentration was varied to determine its effect on the HDT of some polysulfide polymer-modified epoxy systems and some unmodified epoxy systems (Figure 8). Although it had been previously considered that 10 parts of DMP-30 was the optimum concentration based on other tests, these data indicate that higher concentrations give better cures.

A heat distortion temperature of 63° C. appears to be a limit with the DMP-30 room temperature cure whether flexibilizer is used or not. However, if up to 40 phr. of flexibilizers are used, almost double the amount of curing agent is required.

Table 5. Properties of the Thiokol Polysulfide Liquid Polymers.

Trade Name	Crosslinking, %	No. of Repeating Segments, n	M_n
LP-8	2.0	3-4	500-700
LP-33	0.5	6	1,000
LP-3	2.0	6	1,000

Curing Agent Molecular Weight

A study was made in which 10 parts by weight of ethylene diamine, diethylene triamine, triethylene tetramine, and tetraethylene pentamine were each used to cure 100 parts of epoxy resin, both unmodified and modified with 25 parts of polysulfide liquid polymer LP-3. It appears that the unmodified epoxy is greatly influenced by the molecular weight of the linear aliphatic amine; the longer the molecular chain, the lower the heat distortion temperature. This is probably due to the greater flexibility the longer chain introduces.

On the other hand, the HDT of the flexibilized epoxy seems to be proportional to the functionality of the amine used in the cure. Further investigation along these lines appears necessary before any substantial certainty can be attributed to these conclusions.

Flexibilizer Molecular Weight

The polysulfide liquid polymers are commercially available in several molecular weight ranges and with various amounts of cross-linking. Only certain of these polymers are generally suitable for coreaction with epoxy resins. These are shown in Table V with their degree of cross-linking, average number of repeating

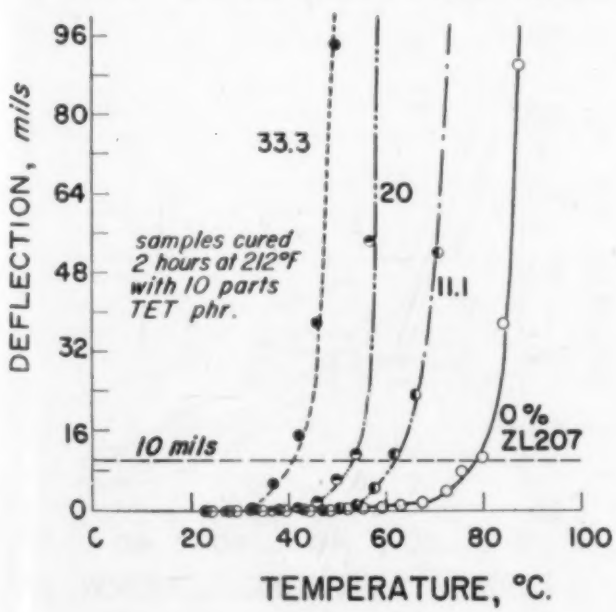

Fig. 11. Typical HDT curves for ZL-207/epoxy resins.

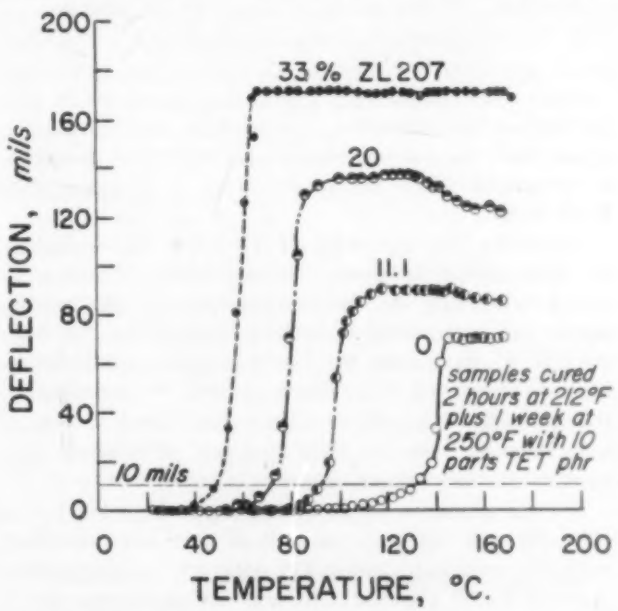

Fig. 12. Typical HDT curves for ZL-207/epoxy thermoset systems.

segments, n, and the number average molecular weight, M_n.

The average heat distortion temperatures at 264 psi. fiber stress are plotted in Figure 9 as a function of the mols of polysulfide polymer used to flexibilize the epoxy resin. Both DMP-30 and TET room-temperature cures are shown. It is apparent that the heat distortion temperature is increased as the amount of cross-linking and molecular weight of the flexibilizer are reduced. However, LP-8 gives somewhat poorer physical properties.

Experimental Polyester Modifiers

Two polyesters were developed by Thiokol Chemical Corp. specifically for modifying epoxy resins. One of these, ZL-206, is an extender for epoxy resins, while the other, ZL-207, is a flexibilizer. These were evaluated for different cure conditions.

In Figure 10, two different cures are shown as the parameter of a plot of average heat distortion temperatures versus ZL-206 concentration. The behavior here is similar to that of LP-3.

ZL-207 also behaves like LP-3 and ZL-206 when it is cured at 212° F. (see Figure 11). However, when long time-high temperature cures are used with ZL-207/epoxy resin systems (viz., one week at 250° F.), the samples exhibit typical thermoset curves (28-30) in which a maximum distortion practically independent of temperature is reached (Figure 12). Although a study was not made, it is possible that an LP-3/epoxy resin system or a ZL-206/epoxy resin system subjected to a similar annealing treatment also would exhibit these thermoset properties.

Curing Agents

Probably the most important single factor affecting heat distortion, other than amount of flexibilizer, is the curing agent used. For any given system, the HDT may be varied as much as 100° or more, depending on the choice of curing agent. Curing or cross-linking of the polysulfide polymer-modified epoxy resins may be carried out by mineral and organic acids and anhydrides, bases, particularly amines of all degrees and types, and various other resins (16). The curing agents which give the highest heat distortion temperatures with unmodified epoxy resin do not necessarily give high heat distortion temperatures when the epoxy resin is modified with flexibilizer.

Dearborn and co-workers (11) report that resistance to deformation at elevated temperatures increases as the functionality or the compactness of the curing agent increases. Heat distortion temperatures as high as 250° C. have been reported using pyromellitic dianhydride cures (12, 13), and over 200° C. for chlorendic or "HET" anhydride. Yet when LP-3 was used with these systems, the HDT dropped off to about one-quarter of the original values.

Several aromatic amine systems give high HDT values, although not quite as high as have been obtained with the acid anhydrides. Of note are metaphenylene diamine (Shell Catalyst CL) and 4,4′-methylene dianiline. With these agents, high heat distortion temperatures have been obtained even when polysulfide polymer flexibilization is used.

Javitz (15) indicates some undesirability connected with these high-heat cure-high HDT materials, such as high shrinkage, tendency to "run" during vacuum impregnation, and the limit sometimes imposed by materials being potted. Nevertheless, where these conditions are not restrictive, these cures generally give maximum heat distortion results. In Table 6, the curing agents and cure conditions corresponding to the curves and points in Figure 13 are listed. It can be seen from these data how the aromatic ring structure of the curing agent tends to raise the HDT. This is probably a result of the molecular rigidity. This configuration introduces and probably explains the high HDT associated with unmodified epoxy resin itself.

Conclusions

The results of this investigation indicate that a wide variation in the heat-distortion temperature of flexibilized epoxy resin systems is possible. This variation is dependent on ratio of flexibilizer to epoxy resin, the selection of resin, the amount and type of curing agent, cure time and temperature, and aging time.

There are certain combinations of conditions which will give heat distortion temperatures for flexibilized systems which are higher than unflexibilized systems. It has been found that about 25-40 parts of polysulfide liquid polymer, co-reacted with epoxy resin, gives an excellent balance of heat distortion temperature with mechanical, physical, and chemical properties.

Conditions which favor high heat distortion temperatures is unmodified epoxy systems do not necessarily incur improved results when flexibilizer is used. Flexibilized and unflexibilized systems must be treated as separate entities.

Flexible systems would necessarily have low heat distortion temperatures, as measured by the standard HDT test. This does not mean, however, that they would lose

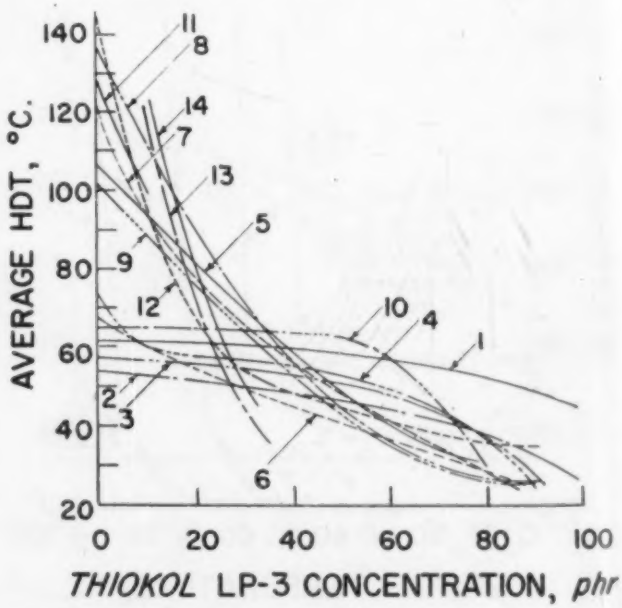

Fig. 13. Effect of LP-3 concentration on HDT of epoxy resin systems with various curing agents.

Table 6. List of Curing Agents Plotted in Figure 13.

Curve No.	Curing Agent	Chemical Name	Cure Conditions*
1.	DMP-30	2,4,6-Tri(dimethyl amino methyl) phenol	Room temperature.
2.	TET	Triethylene tetramine	Room temperature.
3.	Shell Catalyst U	Amine/epoxy adduct	Room temperature.
4.	Shell Catalyst D	2-ethyl hexoic acid salt of DMP-30	1 hr. at 250° F.
5.	Shell Catalyst Z	Mixture of aromatic amines	4 hrs. at 212° F.
6.	Shell Catalyst CL	Meta-phenylene diamine	3 hrs. at 180° F.
7.	Shell Catalyst CL	Meta-phenylene diamine	2 hrs. at 250° F. and 1 hr. at 300° F.
8.	44 MDA	p,p'-Methylene dianiline	2 hrs at 250° F. and 1 hr. at 300° F.
9.	Ari-Temp 105	Amine	1 hr. at 212° F.
10.	DMAPA	Dimethyl amino propylamine	40 min. at 90° F.
11.	BF3-400	Amine complex of BF_3	1 hr. at 300° F.
12.	HET Anhydride	1,4,5,6,7,7-Hexachlorobicyclo (2.2.1)-5-heptane-2,3-dicarboxylic anhydride	2 hrs. at 300° F.
13.	PMDA	Pyromellitic dianhydride (1,2,4,5-benzene tetra carboxylic dianhydride)	Room temperature.
14.	PMDA	Pyromellitic dianhydride (1,2,4,5-benzene tetra carboxylic dianhydride)	17 hrs. at room temperature and 2 hrs. at 250° F.

*Samples aged a minimum of 30 days before being tested.

their shape at elevated temperature; in fact, they could even support a load at elevated temperatures under different conditions of loading. Other methods of testing the elevated-temperature properties of thermosplastic materials are available (31) which may be more suitable than the HDT test.

Acknowledgements

We wish to express our appreciation to Miss J. A. Kruger for her invaluable assistance in carrying out these experiments, and to the Thiokol Chemical Corp. under whose auspices this work was performed.

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—THE END

Color Variations in Coatings for Plastics

(*Cont'd from page 290*)

may vary considerably when exposed to artificial light. Therefore, the production standards should be sprayed with the same type of paint to be used in production. Then both panels would appear alive under either production lamps or north daylight. When there is a question of color variation between the production part and the production standard sprayed with the same type of paint, they should be checked under north daylight.

Changes in Color Standards

Occasionally, standards will be submitted as painted chips, and later new standards will be made up using molded plastic chips. This change often is sufficient to throw the paint off standard during inspection.

PLASTICS TECHNOLOGY ENGINEERING FORUM

Vacuum Forming

Edited by:
E. BOWMAN STRATTON, *President*
Auto-Vac Co., Bridgeport, Conn.

Vacuum forming of sheet plastic is growing so rapidly in popularity that it is looked upon, by the sheet plastic manufacturer and user alike, as the most precocious infant in the whole field of plastics.

The first semi-automatic machines for a complete cycle of vacuum forming were developed in 1947 by the Army Map Service for the large-scale production of relief maps. In terms of today's techniques, these machines used simple cavity mold techniques, forming the plastic into a box-mold from a stationary clamping frame. A surprising amount of the vacuum forming done today is by this basic method, even though great improvements have been made.

The first commercial vacuum forming machine was placed on the U. S. market in 1951. Another manufacturer entered the field in 1952, still another in 1953, at least two more each in 1954 and 1955. At the end of 1955 there were an estimated 800 machines in use. This grew to 1,200 in 1956, which gives some idea of the rapid acceptance of vacuum forming.

Drape forming, an improvement of the basic process, was introduced in 1953. By this method, heat-softened plastic in a clamping frame was draped over a male mold, after which the vacuum was drawn with resultant quick molding of plastic.

The period of 1953-1955 marked intense competition between manufacturers of vacuum forming equipment, and much refinement of machine design. Automatic cycling became common on the better machines. More attention was paid to heater design to insure quick and even heating of the plastic sheet. The requirements for fast production resulted in the application of various cooling devices, such as the water-cooled clamping frame and air circulators for quicker cooling of the formed plastic.

The same period saw an interesting new development for the process. Packagers were quick to seize upon the advantages of visual packaging by use of transparent films formed into bubbles or blisters and card-mounted. Impetus was given to this development by approval and acceptance of this merchandising system by large-volume chain store users. In 1954, skin packing was introduced, wherein the merchandise is held to the mounting card by a transparent film formed skin-tight over the merchandise and simultaneously laminated to the card. This found immediate acceptance from hardware packagers.

New developments in vacuum forming are hampered by the almost too rapid

growth of the industry, the lack of capital for research and development, and the rapid introduction of new plastics (such as Mylar) with markedly different properties.

In 1957, you may look for:

(1) Larger machines, such as the 6 × 4-foot monster for forming parts of sets for TV dramatic productions.
(2) More assist mechanisms, such as drape-assist frames, and plug-assist devices for straight vacuum forming.
(3) Plug-forming machines, utilizing matching male and female molds to form deeper-draw shapes.
(4) Improved heating arrangements to get more and faster heat to the plastic.
(5) Pressure-forming machines, wherein several atmospheres of pressure are employed for faster forming at higher temperatures.

—THE ED

Injection Molding

Edited by
SAUL BLITZ, *President*
Tico Plastics Co.
New York, N. Y.

The technology known as injection molding has made tremendous strides since its infancy of 20 years ago. Its progress is gaining momentum and shows no indications whatsoever of slowing down. This segment of the plastics industry is a young, growing giant. The leap from small, one-ounce comb and button shots to 15-pound plastic housings molded in a 900-ounce press was made in a much shorter time than we could project now to a future press of 10 times the present-day press capacity. I attribute this commendable progress to what I call the "Four M's"—Material, Machines, Molds, and last, but surely most important, Men (and some Women, too).

The injection molder today has available at least five additional groups of thermoplastic materials that were not available commercially 20 years ago when it was mainy cellulose acetate made in a few doubtful formulations and flows. Today, in the cellulosics, polystyrenes, acrylics, vinyls, polyethylenes, and fluorothene resins, the various formulations and flows readily available total into the hundreds and most certainly have served to broaden the uses and applications of injection molded products. Yet, today, one can still hear the molder and customer cry for "a new and more suitable thermoplastic!"

Along with the materials had to come the machines, and it is questionable as to which came first. Nevertheless, the tremendous progress of the equipment industry speaks for itself. Progress from the small, mechanical toggle press to the present-day large pre-plasticizer presses denotes real achievement. On all standard machines today, we have better electrical controls, finer hydraulic systems, and far greater safety built into them. Injection molding presses can be purchased today for specialized services such as, higher speeds, deeper draws, larger molding areas, mulitple nozzles, greater injection pressures, dual color molding, secondary core-pulling systems, and other special functions.

Auxiliary press equipment, once almost non-existent, has become now as necessary as the press itself. We have mold heaters, mold chillers, hopper loaders, hopper dryers, weight-feeding devices, specialized heaters for various materials, and dozens of nozzle and adapter types. These progressive achievements are leading us toward eventual automation in molding.

Since, along with press and material, one must have a mold in order to make the product, it follows that the molds had to keep pace. It is a far cry indeed from the early small, simple tools to the complex molds being used today.

Naturally, the dominating factor behind all this progress is the men. The material suppliers, press builders, mold makers, product designers; and the molders—all contributed foresight, perseverance, experimentation, development, and experience.

The most amazing aspect about this progress, however, is that it has occurred despite the fact that the veil of secrecy is kept over new developments. Very often I've seen several companies each develop a new idea, design, or concept that, not too far away in distance, is being done by others or already is ancient history. Would it not be helpful for all to exchange information on new developments after their initial achievement so that it could hasten us all toward still greater productivity?

This column can serve us all usefully, and is available to everyone for this purpose. In addition, this column will discuss problems of injection molding. —THE ED

The "Coffee Master's" phenolic rim is odorless, imparts no taste, and is unaffected by moisture or hot vapor. Chicago Molded Products Corp. used BMC-2005

The Sunbeam "Coffee Master" has parts made of two BAKELITE Phenolics – general-purpose BMG-5000 and chemical-resistant BMG-2095.

Phenolics

. . . too useful to be outmoded

You've seen phenolics around so long because they have so much to offer. These thrifty plastics thrive on new ideas, keep active on new jobs. One reason for this is their adaptability. They cover a wide range of needs. There are five different categories of BAKELITE Brand Phenolics, made up of dozens of compounds. Among them, you may well find the one with the ideal combination of properties for your product, whether it's well established or still in the planning stage. How long has it been since you looked at them? As a start, glance over the information on the next two pages.

The "Coffee Master's" phenolic rim is odorless, imparts no taste, and is unaffected by moisture or hot vapor. Chicago Molded Products Corp. used BMG-2095.

BMG-2095 . . . *a chemical-resistant phenolic*

This premium chemical-resistant molding material is also useful where moisture resistance, non-toxicity, and minimum odor are necessary.

It is a one-step, cellulose-filled phenolic with good molding latitude, fast set-up, and good mold release.

Dimensional stability is a notable property of BMG-2095. Surface appearance is excellent. Pieces molded from it will not bleed in most organic solvents. As a result, this material is useful for both industrial and consumer applications.

Handles, base, and switch for the Sunbeam "Coffee Master" were molded of BMG-5000 by Chicago Molded Products Corp.

BMG-5000 . . . *a general-purpose phenolic*

BMG-5000—the outstanding development in phenolics by Bakelite Company—is a truly general-purpose material, matching production efficiency with the broadest possible range of applications.

This means economy. BMG-5000, engineered for the best combination of curing speed and molding latitude, assures minimum down-time. It provides rapid set-up and easy release from mold cavity plungers and followers. Its lower specific gravity increases molded items per pound.

BMG-5000 is suitable for compression, plunger, or transfer molding. Products are rigid at hot discharge, can be released from the mold quickly and easily. An exceptional surface appearance results from the uniform shrinkage and absence of warpage and blisters.

TYPICAL PROPERTIES

Values relating to Fabrication	General-Purpose BMG-5000	Electrical-Resistant BMG-0750	Heat-Resistant BMG-8335	Impact-Resistant BMG-2080	Chemical-Resistant BMG-2095
Granulation (D392-38)	16 mesh	16 mesh	12 mesh	6 mesh	16 mesh
Bulk Factor (D392-38)	2.4	2.2	2.1	3.0	2.6
Plasticity Grades Available	4, 6, 9, 12, 15, 18	6, 9, 12, 15	6, 9, 12, 15	9, 12, 15, 18	4, 6, 9, 12, 15
Molding Shrinkage, in./in. (D955-51)	0.005	0.004	0.004	0.006	0.006
Values from Electrical Tests					
Dielectric Strength (D149-55T) Short time, volts/mil	370	385	150	280	225
Volume Resistivity, ohm-cm. (D257-54T)	1×10^{12}	1×10^{13}	5×10^{11}	1×10^{12}	1×10^{13}

	60 c.	1 kc.	1 mc.	60 c.	1 kc.	1 mc.	60 c.	1 kc.	1 mc.	60 c.	1 kc.	1 mc.	60 c.	1 kc.	1 mc.
Dielectric Constant (D150-54T)	5.7	5.3	4.6	4.9	4.7	4.5	20.0	13.0	8.0	11.0	8.0	6.0	22.0	13.0	7.0
Dissipation Factor (D150-54T)	0.07	0.04	0.03	0.020	0.018	0.008	0.25	0.20	0.08	0.21	0.16	0.05	0.30	0.25	0.06

Values from Mechanical Tests					
Izod Impact Strength (D256-54T) ft-lb/inch of notch	0.30	0.34	0.30	0.48	0.25
Compressive Strength (D695-54), psi	34,000	25,000	28,000	28,000	34,000
Tensile Strength (D651-48) (⅛ in.), psi	8400	7000	5000	7500	7000
Flexural Strength (D790-49T), psi	10,000	9500	7000	9000	7500
Modulus of Elasticity in Flexure (D790-49T), psi	10×10^5	22×10^5	12×10^5	8.5×10^5	8×10^5
Values from Miscellaneous Tests					
Molded Specific Gravity (D392-38)	1.34 Black 25 1.36 Brown 15	1.72	1.58	1.37	1.37
Heat Distortion Temp., deg. F. (D648-45T) (½ in.—264 psi)	330	285	340	315	340
Moisture Sensitivity:					
Water Absorption (D570-54T), per cent wt. gain	0.45	0.03	0.2	0.4	0.4
Saturation Constant, per cent	8	1.1	3	4.8	3.5
Diffusion Constant, $cm^2/hr.$	1.3×10^{-5}	1×10^{-5}	1.5×10^{-5}	3×10^{-5}	7×10^{-5}

Bakelite Company has numerous phenolic compounds in other special categories as typified by:

BMG-0750 . . . *exceptional electrical resistance*

Combines excellent electrical and fabricating properties. BMG-0750 meets requirements of Govt. Spec. MIL-M-14E.

Its dimensional stability is excellent—an important property where close tolerances must be held. Its moisture resistance equips BMG-0750 for further success in electrical applications. Most of them—vacuum tube bases, coil forms, capacitor housings, and resistors, for example—make use of both these factors. In molding, BMG-0750 demonstrates exceptionally fast set-up. It has lower "fines" content, better mold release, and less tendency to gassing. Improved molding characteristics make it suitable for either compression or transfer molding.

For information and assistance in applying these or other BAKELITE Brand Phenolic Plastics to your product, write Dept. WQ-130.

BMG-8335 . . . *superior heat resistance*

For long periods of time, BMG-8335 will withstand temperatures as high as 400 deg. F., even as much as 500 deg. F. for shorter periods.

Pieces molded from it have an exceptional gloss that is retained even after exposure to high temperatures. Color retention is also excellent. Consequently, BMG-8335 is widely used for utensil handles and heating appliance components. This mineral-filled two-step phenolic has a relatively low specific gravity. More items can be molded per pound. Finished pieces are compact and light-weight. In addition, they are resistant to wear and abrasion and are dimensionally stable.

BMG-2080 . . . *high impact resistance*

While the impact resistance of this material is its primary feature, BMG-2080 balances this property with a number of others that are important.

Even at elevated temperatures, BMG-2080 displays superior resistance to moisture, soap, and detergents. It performs extremely well where one side of the molding is wet while the other remains dry. It is widely used for pump housings, valve bodies, fill tubes, aspirators, washing machine agitators, sterilizers, and dispensers. As a one-step material, BMG-2080 also offers several advantages in the molding process, notably minimum odor and a rapid rate of cure.

BAKELITE BRAND PLASTICS

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

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In Canada: Bakelite Company, A Division of Union Carbide Canada Limited, Belleville, Ontario.

News of the Societies

SPI West Coast Conference and Exposition a Success

The 1957 annual conference of the Society of the Plastics Industry, Inc., held on March 18-21 at the Biltmore Hotel, Los Angeles, Calif., and its accompanying Pacific Coast Plastics Exposition, at the Shrine. Exposition Hall in Los Angeles, were successful affairs justifying the growing importance of the Pacific Coast area in the plastics industry. Registration at the Conference totaled approximately 875, and the Exposition attracted 10,500 visitors during its length of stay. The latter was a highly respectable figure in view of the fact that the Exposition was not open to the public.

Since the Exposition and Conference programs were the subject of a special feature section in our February issue, our report here will not cover these programs in any great detail, but will concentrate on last-minute changes that took place. For example, the Exposition displays were restricted to the main floor of the Exposition Hall, and there were some additional displays on this floor as the result of a rearrangement of the floor space. In this connection, Semet-Solvay Petroleum Division, Allied Chemical & Dye Corp., occupied Booth No. 133 and showed samples of molded polyethylene items containing their A-C Polyethylene, a low molecular-weight polymer that contributes to the appearance and production of polyethylene injection moldings.

Brief abstracts of some of the Conference papers are given below:

"Reinforced Plastics for Rocket Applications," G. Epstein, J. W. Eberhardt, J. Goldberg, and H. A. King, all of Aerojet-General Corp. The rocket industry will have increasing demands for reinforced plastics. Unique designs and materials were reviewed, and applications were divided into primary and secondary structures, with their service requirements classified according to temperature specifications.

"Self-Expanding Polystyrene Foam, a New Low-Density Molding Material," J. A. Struthers, Jr., Dow Chemical Co. Properties of the foam were reviewed, and applications in temperature-insulating aircraft structures were discussed.

"Fiberglas for Missile Usage," W. J. Schnorr, Mrs. L. W. Eccleston, and T. E. Holdridge, all of Hughes Weapons Systems Development Laboratories. A grading system based upon types of defects in woven glass fabrics led to the development of special weaves of glass that could show distortion of fill yarns. Less distortion results from increasing the bundle of filaments of the fill yarns.

"New Epoxy Resins for Reinforced Plastics," E. W. Krummel, P. A. Thomas, and J. L. Welch, all of Bakelite Corp. Mechanical properties at room and elevated temperatures were given for EP-201, a new diepoxide resin, and several hardeners. The low-viscosity resin can be cured with acid anhydrides.

"Filament-Wound Structures," R. Noland, Reinhold Engineering & Plastics Co. The history of filament-winding of highly stressed components for aircraft and guided missiles was reviewed, and possibilities for automatic operation were considered.

"Plastics in Marine Fields," John Marzicola, Zenith Plastics Corp. Development work on a 36-foot landing craft was described. The hull is of sandwich construction with paper honeycomb core, and reinforced-plastic skins.

"Plastics in the Agricultural Industry," H. E. Pinches, U. S. Department of Agriculture, and C. E. Staff, Bakelite Co. A review of plastics developments and applications in the agricultural field, with particular reference to water management.

"Chemical Properties of Plastics in the Petroleum and Process Industries," R. Seymour, Loven Chemical Co. of Calif. A review of applications in these fields, showing that these usages are based on the temperature, type and concentration of solvents, and type and concentration of corrosives encountered. Emphasis was placed on tanks, tank liners, flumes, and ducts.

"Dylite Polystyrene Foam—A New Concept in Packaging," E. A. Edberg, Koppers Co., Inc. Properties, processing methods, and potential applications of the foam were considered. Expanded structures have excellent energy absorption properties for use in protective packagings of all types.

"Formed Cellulosics—Present Uses and Future Horizons for Packaging," W. M. Ronayne, Celanese Corp. of America. Considerable growth has occurred in formed cellulosic packagings, particularly where transparency is required. Six basic types of formed packages were discussed in detail.

"Zytel Nylon for Packaging," W. M. Ryan, E. I. du Pont de Nemours & Co., Inc. Aerosol containers that are blow-molded from Zytel 4Z were suggested for packaging cosmetics, pharmaceuticals, and other itmes. Data were presented on permeability, environmental testing, and design.

"Significant Factors in Plastic Container Fabrication," R. J. Lee, Dow Chemical Co. Careful planning and selection were shown to be necessary for successful applications of rigid plastic containers.

"The Role of Polyethylene in Creative Packaging and Successful Selling," J. R. Akers, Bakelite Co. Applications of molded packages, squeeze bottles, extruded shapes, and transparent films were reviewed, together with expectations for future developments in the packaging field.

"Evaluation Tests for Epoxy Casting Systems," M. V. Goodyear and J. P. Hornburg, Houghton Laboratories. Heat-aging tests for evaluating performance of epoxy resins at high temperatures were discussed. Good correlation between tests and production applications was noted. Various epoxy resin systems were considered and compared.

"Epoxy Casting Resins for Electrical Applications," W. E. Weber, Hughes Aircraft Co. Growing applications in the field of electrical insulation were reviewed, and electrical property data at elevated temperatures given for selected resin systems.

"Linear Polyethylene and Chlorinated Polyether—Two New Raw Materials for the Electrical Insulating Industry," E. W. Cronin, Hercules Powder Co. Properties of the two materials were given in comparison with those of products currently in use.

"House of the Future," R. P. Whittier, Monsanto Chemical Co. Design engineering, testing, fabrication, and construction by the building trades of the Monsanto "House of the Future" were discussed.

"Special Applications of Linear Polyethylene," H. S. Malby, Celanese Corp. of America. A large growth of linear polyethylene applications is expected this year. The importance of the material to housewares, bottles, and toys was reviewed.

"Design Trends in Plastics Housewares," James Kelson, Packard-Bell Co. Design has proved to be the largest single factor in profitable merchandising. New products are created by the use of form, line, texture, contrast, tension, and color.

Features of the Conference were the keynote address on March 18; the 20th Anniversary Reception, on March 17, honoring the past presidents of SPI; the Conference Luncheon on March 19; and the annual banquet on March 20.

The keynote speaker was Robert Prescott, president of The Flying Tiger Lines who spoke on "The Bee and You," in which he mentioned the plastics, air freight, television, and electronics industries as the four "busy bees" that have contributed to Southern California's post-war growth as an industrial center.

Guest speaker at the Luncheon was Brig. Gen. Thomas Bryan, whose topic was "Time, Technology, and the Threat." Gen. Bryan spoke of the technical war being waged with the Soviets, and how the factors of time and technology are complicating our efforts.

The Annual Banquet was held at the "Moulin Rouge," Hollywood's famous theatre-restaurant, which was filled to overflowing with the SPI members and their guests who enjoyed the program which consisted of the complete floor show,

dinner, and the presentation of SPI officers and local dignitaries.

Many of the registrants at the Conference brought their wives, and the Ladies' Program included a tour of the motion picture and TV studios on March 20; a trip to Disneyland on March 21; and an over-night visit to Las Vegas on March 21 after the conclusion of the Conference.

SPE New York Section

More than 160 members and guests attended the March 20 meeting of SPE's New York Section, held at the Governor Clinton Hotel in New York City. Theme for the meeting was "The Coloring of Plastics," and the program included a six-man panel of experts, plus a movie entitled "This Is Color."

The movie, which described the physics of color, was shown first. Filmed by Interchemical Corp., it was explained in some detail by that firm's RBH Dispersions manager, R. L. Lynch. Panel moderator was F. C. Peterson, Westchester Plastics Co.

R. H. Zabel, pigments department, E. I. du Pont de Nemours & Co., spoke on "Proper Application of Color." He discussed the inorganic pigment colors, which usually are incorporated mechanically, because they have no solubility. These include the lead chromates, the ferrocyanides, iron and chromium oxides, cadmiums, and ultramarine blues. Organic colors were classified as azo-pigment dyes, which include the toluidene reds, hansa yellows, para reds, benzidine yellows, and others; the precipitated-azo pigments, such as the bons and the lithols; and the non-azos, such as the acid-dye lakes, rhodamines, phthalocyanines, and the vat dyes.

Kenneth Roberts, Plastic Materials, Inc., spoke on "Hot-Compounded Colors," admitting that they were more expensive to purchase. He felt that many economies could be achieved with them in the long run, since they lower inventories, cut clean-down time, afford a greater richness of color, and offer exact color control.

Hal Felsher, Claremont Pigment Dispersion Corp., discussed the use of "Color Dispersions." Pre-colored masterbatches can be mixed directly with the plastic material to obtain excellent effects such as outdoor-exposure resistance and absence of streaking. Anti-oxidants and traces of carbon black can be added to enhance these desirable features. Used with epoxies and polyesters, pigments must be light- and heat-stable, have hiding power, tinting strength, and chemical inertness. Certain colors contain reducing agents, such as lead and cobalt, which will inhibit cure. Carbon blacks inhibit the catalyst.

Myles Schneider, American Molding Powder & Chemical Corp., had the topic "Hot-Compounding of Color into Vinyls and Polyethylene." Problems encountered with vinyl coloring involve price, the use of stabilizers, the difficulty of matching a filled compound. Cheap fillers, such as calcium carbonate, tend to change color and opacity, and tri-base stabilizers tend to darken colors.

William Bradbury, Plastic Molders Supply Co., spoke on the "Dry Coloring of Thermoplastics." He pointed out that dry coloring eliminated one entire step in coloring—the extruding of color into plastics. Styrene is the material most commonly dry-colored, and accurate color matches are obtained quickly. Inorganic pigments are best adapted to the method, since many organic dyes have a tendency to bleed. Soft pigments should be used for coloring copolymers and high-impact styrene in order to avoid differences in opacity.

Detroit Rubber & Plastics

The Detroit Rubber & Plastics Group held its first meeting of 1957 on February 1, at the Detroit Leland Hotel. Approximately 200 members and guests were in attendance.

The technical session featured a talk by Carl W. Sweitzer, Columbian Carbon Co., on "Carbon Black Polymer Interactions." The after dinner program consisted of a lecture-demonstration of "Fire Magic," given by Llewellyn Heard, Standard Oil of Indiana.

SPE Baltimore-Washington

Over 70 members and guests attended the February 12 meeting of SPE's Baltimore-Washington Section at Friendship International Airport, Baltimore, Md. Robert Brinkema, Firmaline Products, Inc., addressed the group on "New Fabrication Methods in Reinforced Plastics."

Matched metal molding, plastic dies, and premix compounding were discussed, and Mr. Brinkema gave an on-the-spot demonstration. He formed a compound of 20% polyester resin and catalyst, 15% sisal fiber, and 65% clay. This compound was then molded at 200 psi.

It was pointed out that steel dies invariably are preferred over plastic dies whenever economies permit. A huge chlorinator housing, made with epoxy tooling, was on display with numerous other reinforced plastic items.

SPE-SPI Joint Meetings

SPE's Eastern New England Section held a joint meeting with SPI's Boston-Providence Chapter on March 28, at the University Club in Boston. The topic was "Vinyl Stabilizers," and more than 200 members attended.

Norman Perry, Argus Chemical Co., discussed the use of barium-cadmium in combination with zinc and various salts; A. Scarborough, National Lead Co., traced the development of organo-lead compounds; and Gerry Mack, Metal & Thermit Corp., spoke on specific organo-tin stabilizers.

STEARATE HEADQUARTERS

METASAP

There are ample and compelling reasons why Metasap, the nation's largest producer of stearates, is known from coast to coast as "Stearate Headquarters". The unvarying uniformity and extreme purity of Metasap Stearates are recognized wherever stearates are used. If you have special needs—Metasap is equipped to formulate custom-made stearates to meet them.

Our skill with stearates is complemented by our nation-wide distribution facilities. Whatever your needs, you'll fill them best by submitting them to "Stearate Headquarters"—Metasap.

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Barium *Magnesium*
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Aluminum Palmitate
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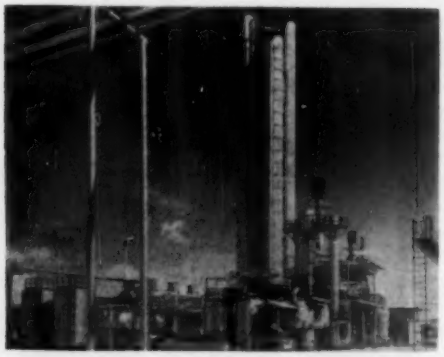
News of the Industry



Cosden's new styrene plant in Big Spring, Tex.

Direct-Recovery Styrene Unit

The first commercial unit for producing styrene by the direct recovery of ethylbenzene from gasoline officially went into operation on April 3, at Big Spring, Tex. The plant, expected to reach a 20-million pound capacity within the first year, is owned and operated by Cosden Petroleum Corp., custom refiners.

Badger Mfg. Co., Cambridge, Mass., designed both the process and the plant. The entire unit, including four 200-foot distillation towers, was completed by Badger in 13 months. The cost was approximately $3-million. Product purity at the end of the first day's run was reported at 99.2%, well above the specifications for plastic-grade styrene.

Cosden starts with a mixed xylene stream from its BTX plant. The ethylbenzene is separated in the Badger Ultrafractionation columns with a critical boiling-point differential of only four degrees between the stream constituents. Then the ethylbenzene is converted to styrene utilizing new Badger techniques of dehydrogenation, recovery, and purification.

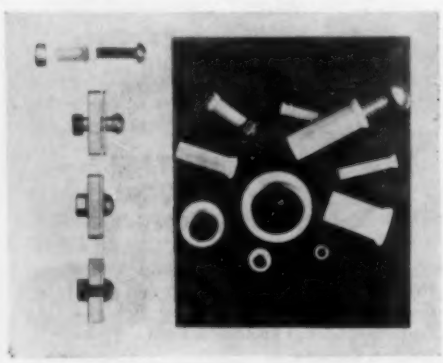
Since initial adjustment of the electronic gages and controls, the plant has been running with 100% automation. About 30% of the initial styrene output is said to be committed to Seamless Rubber Co. for plastics use, and the balance contracted tentatively to Phillips Chemical Co. for its Borger, Tex., synthetic rubber plant. The original contract runs for five years, according to reports; however, plans already are under consideration for expanding the facilities to include polystyrene production.

Cadillac Names Award Winners

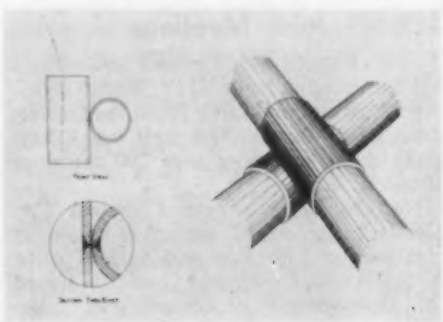
A nylon sleeve, designed so as to cold-flow into a seal between work, bolt, and nut, won first prize in the open classification of Cadillac Plastic & Chemical Co.'s contest for thermoplastic rod and tube applications. William Gould, Keystone Plastics, Inc., Union, N. J., was the recipient of the $1,000-award.

The student first prize of $250 was awarded to Calvin Lee Payne, Jr., University of Cincinnati, for a sliding joint of nylon tubing. Cited as "simple and marketable," it would be of particular use in collapsible furniture or machinery. Mr. Payne also won one of the two student second prizes for a decorative screen of acrylic half-tubes.

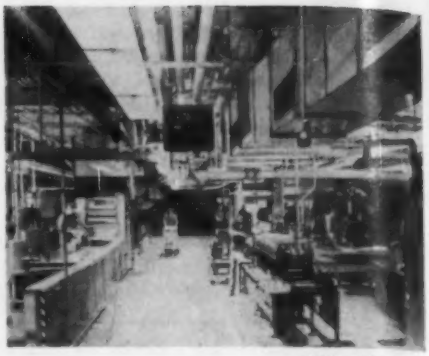
Second prize in the open contest went to Alexander S. Kellner of Controlled Atmosphere Enclosures, Inc., for a square air-lock with rounded corners for a research enclosure. It was formed from a cast acrylic cylinder. The other student prize was awarded to Carl Hall, University of Iowa, for a transparent clock with dial and case formed out of two acrylic cylinders. Third prize, open category, went to Martin H. Pollack, Enley Products, Inc., for an ion-exchange purifying unit of acrylic tubing.



Nylon sleeves win "open" first prize.



Student first prize award for a sliding joint of nylon tubing.



William M. Rittase

Part of operating area at Du Pont's fiber lab.

Synthetic Fibers Research Lab

The $2-million Industrial Products Research Laboratory of E. I. du Pont de Nemours & Co., Inc., is playing a key role in the rapid expansion of industrial markets for man-made fibers. Located in Newport, near Wilmington, Del., the lab has over 40,000 square feet of space for physical testing laboratories, semi-works, and offices. A force of 160 operates on a two-shift basis for a total of 16 hours per day, five days a week.

Du Pont's textile fibers department established the laboratory for research on rayon, acetate, nylon, Orlon, Dacron, and Teflon. It also serves the textile & industrial products research division, carrying out major research functions in cooperation with the department's merchandising and technical service organizations, fundamental research laboratories, and manufacturing plants.

Among the programs conducted by the laboratory are research and evaluation of rayon and nylon tire cords, vinyl - and neoprene-coated nylon, synthetic fiber-reinforced plastics, synthetic-fiber paper, Teflon cloth, and felts from synthetic fibers. Russell W. Peterson is research director of the textile & industrial products research division, and Richard W. Nebel is director of the laboratory.

Borden Enters Second Century

Coincident with entry into its second century of business, Borden Co., New York, N. Y., has announced plans for expanding and modernizing physical facilities to the extent of $150-million over the next five years. A major portion of this amount will be provided by depreciation accruals and retained earnings; the remainder by larger leasing arrangements.

According to Harold W. Comfort, president, "Borden had its best year in 1956, with sales at $875-million and profits over $23-million." He predicted that 1957 sales would amount to $940-million, another all-time high. In the past 100 years, Borden has grown from three owners to almost 49,000 stockholders; from 10 employes to 33,000; from one plant to more than 700 business locations; and from one product, condensed milk, to more than 800 products.

announcing
dinonyl phthalate

—a new Eastman plasticizer

DNP offers outstanding performance at significant savings

We invite you to evaluate the usefulness of this new plasticizer in your vinyl formulations. Our testing indicates the following advantages:

LOW COLOR • Dinonyl phthalate has an initial color of less than 25 APHA. After heating for 2 hours at 220°C., retention of this low color has proved excellent.

PERMANENCE • All permanence tests indicate dinonyl phthalate to be equivalent or superior to dioctyl phthalate. These tests include resistance to high temperatures, activated carbon volatility, migration and extraction by soapy water and heptane.

ECONOMY • Based on current prices of vinyl resins and plasticizers, 102 square feet of dinonyl phthalate plasticized vinyl compounds can be produced for the same cost as 100 square feet of compounds plasticized with DOP. This savings assumes the use of 57 parts per hundred resin of dinonyl phthalate as compared with 50 PHR of dioctyl phthalate. Basis for this is the greater amount of dinonyl phthalate required to produce an equivalent modulus and the resultant lower density of the dinonyl phthalate formulations.

SUPERIOR ELECTRICAL PROPERTIES • Dinonyl phthalate exhibits a high dielectric constant, a low dissipation factor and a volume resistivity equal to or better than that of electrical grade dioctyl phthalate. These excellent properties recommend dinonyl phthalate for use in vinyl plastics designed for electrical applications.

EASY HANDLING • Dinonyl phthalate is easily milled into vinyl resins.

USEFUL IN PLASTISOLS • Low initial viscosity build-up is an important feature of vinyl plastisols containing dinonyl phthalate. Films cast from these plastisols show good low temperature properties and low plasticizer volatility. Dinonyl phthalate plastisols are suitable for both slush and cavity molding.

Write for working samples and further technical information on this promising addition to the plasticizers available to vinyl formulators.

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KINGSPORT, TENNESSEE
subsidiary of EASTMAN KODAK COMPANY

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

Cellulose Bands Boost Sales

Tests designed to measure the effectiveness of neckband packaging on certain food-store products show a 17.9% sales increase for the banded packages. Du Pont's Cel-O-Seal cellulose bands, used as seals or labels, consistently out-sold unbanded packages of the same products, as determined by purchases of 20,600 glass-packaged items in 10 supermarkets in the New York and Philadelphia areas.

Percentages varied from 44.1% for gallon jugs of bleach down to 3.4% increase for neckbanded condiments. The survey does show, however, that the often-neglected top of the bottle can provide an important sales impact for every glass package.

Cel-O-Seal bands are distributed nationally by Armstrong Cork Co. Applied wet, they shrink on drying to provide a sanitary, tamper-proof seal. The bands can be applied by hand or by machine.

Plastics at the Toy Fair

Plastics were very much in evidence at the 1957 Toy Fair in New York City. Ranging from educational toys to miniature furniture and soda dispensers, the plastic items were bigger, more durable, and more intricate than ever before.

A 14-inch salvage boat complete with diver was molded by Ideal Toy Corp., from Monsanto's high-impact Lustrex styrene. Trim Molded Products displayed its complete Coca-Cola dispenser with child-size Lustrex glasses. Plastic hobby kits are cashing-in on the popularity of the do-it-yourself movement.

Caldwell Products displayed a complete bowling set made of impact-styrene, and Renwal Toy Corp. featured plastic sets of the Panama Canal, a city zoo, and a manually-operated draw bridge. Bandleader Richard Himber was on hand to demonstrate that plastic musical instruments, manufactured by Spec-Toy-Culars, Inc., really play music.

Catalin Corporation Realigns

Formation of a new chemical division within Catalin Corp. of America, and the realignment of thermosetting and thermoplastic sales on a divisional basis have been announced by Catalin president, Harry Krehbiel. The move is expected to provide greater sales concentration in each specialized field, and the organizational structure for future company growth.

New sales divisions and their heads are as follows: thermosetting division, Edward W. Bastian; thermoplastic division, Frank E. Hadley; and chemical division, Paul A. Krentel.

Scratch-proof control panel has surface made with Mylar-to-metal bond.

Develops New Bonding Process

A new process for bonding Du Pont's Mylar polyester film to a variety of rigid and flexible materials has been developed by Seiberling Rubber Co., Newcomerstown, O. A special thermosetting adhesive is applied to the surface of the material to be covered; the film is put in place; and heat and pressure are applied through a giant, flat-bed press designed by Seiberling engineers.

Fabricators working with materials bonded to Mylar can reshape them without damaging the film. In addition to stamping and drawing, they can be nailed and studs can be spot-welded on the rear sides of metal backings. Suggested applications include coverings for radio cabinets, air conditioners, refrigerators, restaurant counters, and auto trim. Embossed film also can be bonded.

Heyden Acquires Newport

Heyden Chemical Corp., New York, N. Y., has acquired the assets of Newport Industries, Inc., and has changed its corporate name to Heyden Newport Chemical Corp. Newport's business will be continued under its present operating management as Newport Industries Co., a division of Heyden Newport.

The Heyden board has been enlarged to include seven members designated by Newport, in addition to the nine regular directors. Simon Askin will serve as president and chief executive officer of the combined firms, and Armin A. Schlesinger has ben elected chairman of the board. Total sales for the two firms were approximately $46,500,000 in 1955, and 1956 assets were estimated at $60-million.

The combined companies are expected to be in a stronger position to carry out expansion plans, and will combine sales and research activities. Heyden is a major producer of pentaerythritol, formaldehyde, and other chemicals used in the protective coatings and plastics industries. Newport is the second largest producer of naval stores, and a pioneer supplier of tall oil and wood chemicals.

Expands Research Facilities

Plans have been announced for a $1,500,000 addition to the main installation, Building No. 323, of Du Pont's polychemicals department, located at the experimental station near Wilmington, Del. The addition will comprise a three-story wing of red brick, and will house 18 two-man research laboratories, six offices, and a roof enclosure to accomodate special equipment.

Research at the polychemical experimental station includes basic studies in the synthesis of organic chemicals, high polymers, and specific work in the field of plastics. Products developed by the department include Zytel nylon resin, Alathon polyethylene, Lucite acrylic, Teflon tetrafluoroethylene, and Delrin acetal resin.

Vacuum Metallizing Process

A high-speed, vacuum process for depositing metallic coatings on rolls of plastic film, textile fabrics, and paper has been developed by National Research Corp., Cambridge, Mass. Material rolls are placed in a vacuum-tight tank. Air is pumped from the chamber by a system of high-vacuum pumps until the pressure is reduced to about one-millionth atmospheric.

The roll is unwound past a source of molten metal, usually aluminum, which has been heated to a temperature above 1,200° C. Aluminum vapor condenses on the roll surface producing a thin, but bright film. The roll is rewound and removed.

National Research is commercializing the process through NRC Vaculite Corp., a wholly-owned subsidiary which was formerly known as Foiltone Products, Inc. The main commercial success to date involves the vacuum metallizing of Mylar, Du Pont's polyester film. This film can be laminated to vinyl, rubber, or cloth and used in many decorative applications.

Durez To Market Polyesters

Light-colored polyester molding compounds, processable with standard phenolic dies and molding equipment, will be available in commercial quantities from the Durez Plastics division of Hooker Electrochemical Co., early this Fall. An $80,000 concrete and steel building is being erected at the main plant in North Tonawanda, N. Y., and nearly $500,000 will be spent on manufacturing equipment.

The new polyesters, in granular and

powder form, have been available in pilot-plant quantities for the past two years. Intended for non-reinforced, luxury moldings, the materials will be available at 42-77 cents per pound. Beige, green, blue, yellow, turquoise, and pink have been produced. Dimensional stability, heat resistance, and improved electrical properties are reported, together with excellent shelf-life.

Fabric-Backed Vinyl Films

A four-mil vinyl film laminated to a cotton fabric backing has been introduced by the Velvetex division of Velveray Corp., New York, N. Y. Featuring ease of application and durability, the wall covering is expected to compete price-wise with the better grades of papers found in hotels, offices, institutions, and homes. Triple-weight, heavy-embossed Velvetex is available for the quality market. A specially-formulated paste of higher-solids content is marketed by the firm.

Enters Rigid-PVC Pipe Field

A 30,000-square foot plant has been opened by Corroplast, Inc., for the extrusion of unplasticized PVC pipe, duct, and sheet. Located at 100 Dayton Ave., Passaic, N. J., the plant's production will be marketed by Joseph T. Ryerson & Son, Inc., under the tradename Ryertex Omicron.

Corroplast has developed its own formulation, and has installed specially-constructed machinery for its processing. Special features of the firm's output will include pipe up to 12 inches in diameter; extruded ducting up to 14 inches; and continuous, extruded sheets in all standard gages.

Announces Melamine Council

The formation of a Melamine Council by 17 molders of melamine dinner-ware was announced on February 7. Designed to stimulate sales of the dishes, which account for over 90% of melamine production, the council is pledged to maintain and promote the best interests of those engaged in the manufacture of melamine dinnerware.

Promotions are planned, and many media will be used to increase the prestige of the industry. Comparison studies will be made on competing products, and statistical information will be compiled and disseminated to both the industry and the public. Affiliation with the Melamine Council will be open to all who produce, mold or fabricate dinnerware from melamine.

Opens Formaldehyde Plant

The chemical division of Borden Co., has become the largest producer of formaldehyde on the West Coast through its new plant in Kent, Wash. An annual capacity of 36-million pounds is scheduled, produced by the Karl Fischer, West German process. This new process is said to give a 93% yield, as opposed to the usual 82-88%.

The Kent opening raises Borden's West Coast operations to five, for a total of 25 domestic and foreign production facilities. Other plant openings are scheduled for 1957.

Buys Wire & Cable Business

The wire and cable business of United States Rubber Co., New York, N. Y., has been purchased by Kaiser Aluminum & Chemical Corp.; including the plant, property, and equipment in Bristol, R I. In addition, Kaiser will take over U. S. Rubber's wire and cable inventories, sales organization, and distribution network.

The 1,400 wire and cable employees will be transferred to the Kaiser organization, and the same or equivalent employe benefits will be maintained. U. S. Rubber decided to get out of the wire business, feeling it to be more closely allied to the metals field than to rubber. They will continue, however, to supply the rubber used for wire insulation at the Bristol plant.

In Brief . . .

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has exercised an option to purchase a plant site of about 600 acres by the Mississippi River about 27 miles north of New Orleans, La. The option was taken by the firm's polychemicals department to provide for possible future expansion of the department's business.

Ram Chemicals, Inc., Gardena, Calif., has been named the new western sales and service representative for Marblette Corp., Long Island City, N.Y.

Guardian Chemical & Equipment Co., Ltd., Montreal, Que., has been appointed sales representatives throughout Eastern Canada for the full line of corrosion-resistant plastics made by Haveg Industries, Inc., Wilmington, Del. Guardian, a recently-formed firm, has offices and warehouses in Montreal and Toronto.

Plastics Color Co., Summit, N. J., has broken ground for a new plant which, when finished, will double the firm's production and laboratory facilities. The new plant will adjoin the old works at 233 Broad St., Summit, N. J.

(*Cont'd. on page 332*)

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* *Internal plasticizers for polyvinyl acetate*
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CHEMICAL PROGRESS WEEK-APRIL 8-12

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DOF Di-2-ethyl hexyl Fumarate	DOM Di-2-ethyl hexyl Maleate
DBF Dibutyl Fumarate	DBM Dibutyl Maleate

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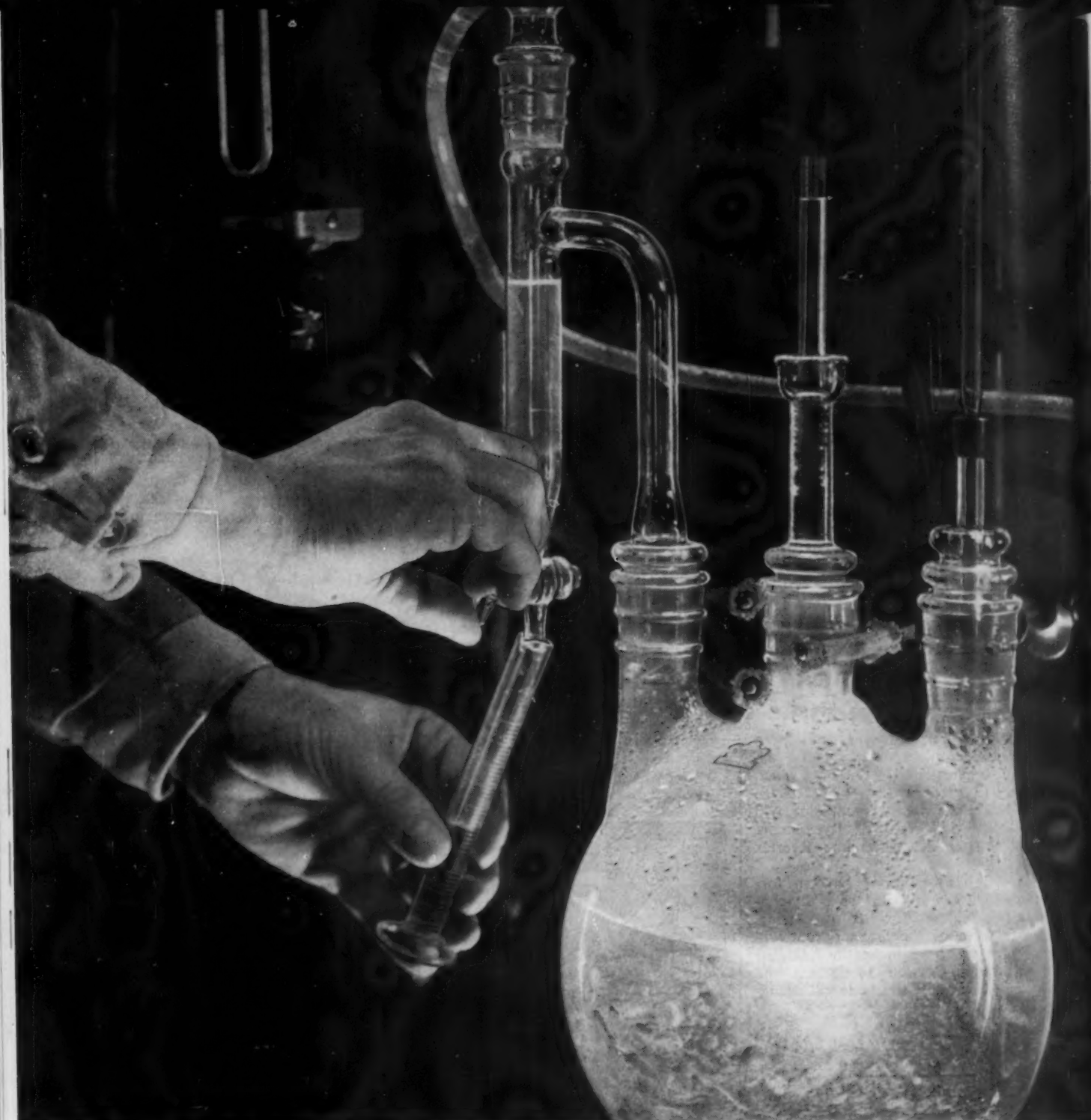

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News from Abroad

British Team Visits Russia

On October 12-31, 1956, a three-man team from the British plastics industry (and including H. P. Bridge, British Molded Plastics, Ltd.; J. Lesser, Crystalate, Ltd., and Ebonestos Industries, Ltd.; and R. Sternberg, Sterling Molding Materials, Ltd.), visited the U.S.S.R. to study the Russian plastics industry and the possibilities for interchange of technical and commercial information, as well as for trade relations between the plastics industries of Britain and Russia.

The Russian Ministry of the Chemical Industry, which controls and organizes the production of plastics, arranged for visits by the team to eight chemical and molding plants and to the Institute for High Polymers, in Leningrad. From the report presented before the British Plastics Federation, it appears that the plastics produced in Russia go to two categories of processors: (1) telephone, building, and electrical engineering plants and the like, many of which have their own "consumer" molding departments; and (2) "trade" molders. The molding factories visited belonged to the second group; some of the largest also produce raw materials.

The Karboit plant, near Moscow, makes produces crystal-clear polystyrene of good quality, in addition to polyvinyl butyrate, polyvinyl acetate, polyvinyl formaldehyde plasticizers, and extruded polystyrene thread (for insulation windings). Its annual output capacity of the polystyrene is about 2,000 tons. The firm now is experimenting with silicone coating resins.

Cellulose acetate, urea-formaldehyde, and compounded PVC materials are produced by Vladimir Chemical Plant, about 100 miles from Moscow. This company employs 2,500 persons, and also makes calendered rigid PVC sheet, extruded rigid PVC tubing, and pipes and joints of phenolic resin and asbestos.

The Karbolt plant, near Moscow, makes urea and phenolic resins and molding powders. It has compression and injection molding sections, with 300 hydraulic compression presses ranging from 25-2,000 tons in capacity, and 25 injection presses ranging from 2-32 ounces (the latter mainly semi-automatic). This plant, said to be one of the largest in the U.S.S.R., produces about 24,000 tons of molding powder (90% phenolic) annually, and employs 3,500 persons. The delegation was told that five other similar plants operate in the country.

The Okhta Chemical Combine, Leningrad, employs 5,000 persons, and produces triacetate, cellulose nitrate, ethyl cellulose, and polyethylene. It also compounds and processes PVC into plasticized sheet, rigid sheet, and tubes. Polyethylene is produced at high pressure at the rate of about 30 kgs. per hour per unit. The cellulose nitrate is used for blown toys and decorative articles.

The Karacharavo plant, near Moscow, does compression and injection molding. Its equipment includes 200 hydraulic presses ranging from 15-200 tons in capacity; a battery of 12 fully automatic 100-ton Watson-Stillman presses; and 32 injection machines ranging from 2-8 ounces.

The delegation noted that most of the equipment in the factories visited was of Soviet make, with a certain proportion of German machines and a few from Czechoslovakia. There seemed to be very little, if any, British machines. Of United States manufacture, only the above Watson-Stillman units were mentioned.

The High Polymer Institute, Leningrad, which covers about 12 acres and is devoted to plastics research and development, was found to have extremely well equipped laboratories suitable for work on most thermoplastic and thermoset materials. Again, most of the apparatus was of Soviet make, with only a few of German origin. The Institute also is working on polytetrafluoroethylene, and experimentally produced samples in strip and block form were seen.

Among the plastic products noted at the factories were simple and fancy goods and toys; rigid PVC sheet and tube; pipes and joints of phenolic resin and asbestos compounds; refrigerator door liners; large, semi-circular molded bearing housings of phenolic and paper or fabric laminate; industrial and decorative panels and tubes of phenolic and paper or board laminates; PVC-coated fabrics for upholstery, PVC sack linings and insulated wire; and battery accumulator cases from a compound including bitumen, Kieselguhr, and cotton flock.

The general impression carried away by the British delegates was that, on the whole, molding was confined chiefly to articles and components of relatively simple design which do not require very intricate tools. It is suggested, however, that more complex articles and precision components may be produced by the factories the delegation was not able to visit. Operators, especially at the largest plants, worked speedily and efficiently; however, finish was found to be below acceptable British standards, as were the safety conditions. The latter situation must have been all the more surprising in view of the extent to which female workers are used, even in operations which in Britain are performed exclusively by men. On the other hand, canteens and factory medical services were first class. The delegation concluded that the U.S.S.R. market, once it is open, has great potentialities, and that the British plastics industry should be able to play a part in the large, unfulfilled market that still exists there.

Ships Styrene Monomer to Japan

The first bulk shipment of styrene monomer to Japan was made by Dow Chemical International, Ltd., from its Texas division at Freeport. The shipment consisted of 1,500 long tons, which were pumped from shore tanks into the cargo tanks of the German ship, Claere Jung.

Upon arrival at Yokohama, the monomer was turned over to Asahi-Dow, Ltd., a Japanese firm which has just opened a polystyrene plant. Far Eastern manufacturers will then be able to mold the granular material into a wide variety of commercial items. Previously, all polystyrene molding materials had to be imported.

Polyethylene Output to Rise

The German firms of Badische Anilin & Sodafabrik A.G., Ludwigshafen/Rhein, and the Deutsche Shell A.G., Hamburg, have decided on a considerable increase in the production of polyethylene by their joint subsidiary, the Rheinische Olefinwerke G.m.b.H., Wesseling. The last-named company, which began to operate in the fall of 1955 and, at present, is making polyethylene at the rate of 10,000 tons per year, is to raise its annual output to 30,000-35,000 tons. The planned expansion, which will cost 140,000,000 DM. is expected to be completed by the end of 1958.

Rheinische Olefinwerke also will erect its own plant for producing the ethylene it will need for the greatly increased output of polyethylene. It will use a process based on light benzene which has already proved successful in other countries. At present, the company obtains ethylene from gaseous by-products of petroleum refining at the Union Rheinische Braunkohlen-Kraftstoff A.G., also in Wesseling. It is planned to continue making chiefly high-pressure polyethylene (Lupolen H) from the ethylene, in addition to ethyl benzene. At the same time, the question is being intensively studied as to whether and to what extent Rheinische is to undertake the production of other ethylene polymers resembling Lupolen that will tend to expand the field of application for polyethylene.

The Badische Anilin & Sodafabrik A.G., will continue to act as selling agent for all types of Lupolen produced by Rheinische Olefinwerke.

Names in the News

Harold M. Parsekian

Photos by Pach Bros., N.Y.

Earle S. Ebers

Thomas F. Long has been named vice president in charge of sales at Alpha Plastics, Inc., Livingston, N. J. He was previously associated with William C. Henick Ink Co. In his new position, Mr. Long will direct all phases of the marketing of Alpha's PVC pipe, tubing, valves, and fittings.

J. W. Mighton has been named to head up the molding section, plastics technical service, for Dow Chemical Co. He succeeds **Gordon B. Thayer,** who was recently named plastics specialist. **Richard J. Lee,** customer service engineer in the film section, replaces Mr. Mighton as head of the sheet forming section.

J. A. Almquist has retired as assistant general manager of E. I. du Pont de Nemours & Co.'s polychemicals department after a long career in research and management. He is succeeded by **Walter H. Salzenberg,** assistant general manager of the Grasselli chemicals department. **Wallace E. Gordon,** former director of the advertising department.

G. M. Scales

G. M. Scales has been appointed technical sales manager for the plastics division of Ciba Co., Inc., Kimberton, Pa. **Elliott N. Dorman** has been named assistant technical sales manager, and **J. B. Durra** becomes advertising and sales promotion manager.

J. R. Howell, R. W. Lindberg, and **Julian Paul** have been named assistant district sales managers for Carbide & Carbon Chemicals Co. Mr. Howell will serve the Chicago district; Mr. Lindberg, Cleveland; and Mr. Paul, Boston. All three men were former technical representatives.

Irwin F. Smith, Jr., has joined Stauffer Chemical Co., as an industrial engineer. He will be located at the molded products division, Los Angeles, Calif.

Albert W. D'Armond has been appointed sales manager of Wabash Rubber & Plastics Corp., Seymore, Ind., a subsidiary of H. O. Canfield Co. He formerly served as sales manager of General Tire & Rubber Co.'s industrial products division, and as Midwestern sales manager for Canfield.

Robert M. Morris has been appointed assistant general manager of Monsanto Chemical Co.'s organic chemicals division. He previously served as the division's director of manufacturing. **Howard L. Minckler,** former manager of the firm's John F. Queeny plant, succeeds Mr. Morris and, in turn, is replaced by **Russell L. Miller. Richard J. Kozacka,** general superintendent of inorganic division manufacturing, fills Mr. Miller's post. **John F. Thompson** succeeds Mr. Kozacka.

Gage Olcott has been appointed head of the merchandising section, plastics sales, for Dow Chemical Co., Midland, Mich. He succeeds **Amos L. Ruddock,** who was recently named sales manager of the textile fibers department. Mr. Olcott joined Dow in 1944, and has been a member of the plastics merchandising staff for the past six years.

Walter W. Tesch has been appointed sales representative for Stanley Chemical Co., in Southern New Jersey and Southeastern Pennsylvania. He was formerly employed by U. S. Rubber as a physical test supervisor in its control laboratory.

John Marco has resigned as president of Marco Co., Inc., to take a new post as president of Marco Development Co., Inc. The latter firm is concerned with the design of continuous production equipment.

C. O. Schwahn has been named product specialist for latex materials by Bakelite Co., and specifically will investigate these materials as they relate to surface coatings. He has been a technical representative for the surface coatings division since 1946.

William A. Perry, Jr., has been added to Goodyear Tire & Rubber Co.'s packaging films staff. A Goodyear employe since 1942, Mr. Perry was formerly on the operating staff of the films & flooring division.

Earle S. Ebers, former general sales manager, has been appointed assistant general manager of United States Rubber Co's Naugatuck Chemical division. **Harold M. Parsekian,** assistant general sales manager, has been promoted to general sales manager succeeding Mr. Ebers.

Ward B. Sanford has been appointed to the Eastern sales office of Minnesota Mining & Mfg. Co.'s reinforced plastics division, Ridgefield, N. J. He joined the firm in 1949 as a mechanical engineer, serving with the factory administration department.

John Peterson has been appointed Midwestern sales manager for W. R. Grace & Co.'s polymer chemicals division, and will maintain offices in Chicago, Ill. He was formerly with Du Pont and the Westvaco division of Food Machinery & Chemical Corp.

Cordo Chemical Corp., Norwalk, Conn., has appointed the following officers: **George H. Sherrard,** executive vice president; **Grant Brown,** vice president and technical director; **Robert G. Forsythe,** resident vice president at the Mobile, Ala., plant; and **William F. Condon,** vice president of Cordo Molding Products, the Cordo sales affiliate.

F. A. Sherwood, associate director of engineering at Monsanto Chemical Co.'s Texas City plastics plant, has been named to head up a special project on the location and evaluation of petrochemical and polymer plant sites. **John M. Chamberlin** has been appointed assistant director of engineering, and will be responsible for the development engineering programs.

Charles W. Boyle has been appointed constrution manager of Plasteel Products Corp., Washington, Pa. Former district manager in the Philadelphia area, Mr. Boyle will be in charge of Plasteel installations on a nation-wide basis.

Howard A. Tenney, Jr., has been named assistant sales manager, raw materials, at the Texas City, Tex., plant of Monsanto Chemical Co.'s plastics division. He previously sold in the Detroit, Cleveland, and New York areas.

N. E. Bolton, R. B. Gosnell, R. J. Hanna, M. A. Stephens, and **G. W. Warren** have joined the development department at Carbide & Carbon Chemicals Co's plant in South Charleston, W. Va.

J. Virgil Waggoner has been appointed raw materials sales manager for the Texas City, Tex., plant of Monsanto Chemical Co.'s plastics division. He was formerly assistant sales manager. **R. R. Wilson,** assistant sales manager of the New England district, has been promoted to sales manager of the Detroit district.

Valentine B. Chamberlain, Jr., has been appointed sales manager of Stanley Chemical Co., a subsidiary of Stanley Works. He succeeds **Arthur B. Sherry,** who recently resigned. Mr. Chamberlain joined Stanley in 1941, and has been serving as assistant sales manager in charge of national accounts.

Fred P. Quartarone

Fred P. Quartarone has been appointed sales manager in charge of institutional products for the Bolta Products division of General Tire & Rubber Co. He succeeds **Sumner L. Trilling,** who was recently named general sales manager of Bolta Products. Mr. Quartarone has been with Bolta since 1936, and has an extensive background in production as well as sales.

E. A. Barr has been appointed assistant manager of Bakelite Co.'s new-product engineering department, and will have offices in New York City. He previously served as assistant director of the extruded products division, Bound Brook, N. J.

Kirk E. Smith, Edward M. Fox and **John W. Bloom** have been added to the sales staff of Celanese Corp. of America's plastics division, and will cover the Northwest, New England, and the Midwest, respectively.

W. Leon Harper has been appointed sales manager for the industrial products and Tile-Tex divisions of Flintkote Co. He is well known in the flooring trade and industrial construction field, having served in several sales capacities since joining Flintkote in 1941.

Alfred M. Nissen has been appointed as a technical representative of Bakelite Co., in the Chicago area. He joined the firm in 1953 as a chemist.

James D. Larkin has joined the research department of Monsanto Chemical Co's plastics division, Springfield, Mass. He previously worked as a chemical engineer for Ethyl Corp. **Kenneth L. MacIsaac** has been named assistant district sales manager for the New England area. **William F. Bridenbaugh** has joined the maintenance department of the plastics division's Texas City plant, after four years with Celanese Corp.

J. C. Findlan has been appointed sales manager for the industrial chemical division of Geigy Chemical Corp., Ardsley, N. Y. He has been a field representative for the firm since 1953, serving in the East Central and South.

A. N. Wohlwend, director of commercial development for Escambia Chemical Corp., has been elected vice president. He joined the firm last year, and has been associated with the chemical industry for many years in both development and production. **Erhart K. Drechsel,** former new product development manager for American Cyanamid Co., has joined Escambia's commercial development department.

Joseph P. Healey has joined Standard Tool Co., Leominster, Mass., as general sales manager. Previously vice president and sales manager of Manco Products, Mr. Healey will maintain headquarters in Buffalo, N. Y.

Ray Neubecker has been appointed representative for Lester-Phoenix, Inc., in the state of California. He has a background of over 15 years experience in the plastics and die casting industry.

Eugene F. Hoffmann has been named manager of U. S. Industrial Chemicals Co.'s Cincinnati sales office, succeeding the late **Elmer Bulthaup.** He has served that sales office for the past six years.

William E. Cass has joined the staff of Arthur D. Little, Inc., a consulting research company of Cambridge, Mass. He formerly served as manager of new product development for General Electric's chemical and metallurgical division.

A. T. Callas has been appointed as a technical representative for Bakelite Co.'s surface coatings division in the Detroit area. He joined the firm in 1954.

Frank Pyle

Frank Pyle, former works manager for Spencer Chemical Co.'s polyethylene plant at Orange, Tex., has been elected vice president. He will head up the firm's plastic division, including promotion, sales, and product development in the polyethylene and nylon fields.

Robert S. Mathews, manager of the vinyl plasticizer department, Archer-Daniels-Midland Co., has been elected an assistant vice president. A company employe since 1937, Mr. Mathews served successively as technical salesman, manager of the Cleveland office, and sales manager for marine oils. He replaces **Walter G. Andrews,** who becomes vice president and is currently serving as manager of the resin & plastics division.

Raymond E. White, manager of product control for Pro-phy-lac-tic Brush Co., has transferred to the Prolon division as special representative in its sales department. He will handle sales and technical contacts in the upper New York state and eastern Ohio areas. Responsibilities formerly handled by Mr. White in plastic molding will be divided between **Leonard Oswin** in the thermoplastic division, and **Robert Blondin** in the thermosetting division.

Eric Stahlberg, Jr.

Eric Stahlberg, Jr., has been appointed production superintendent of Prophylactic Brush Co.'s plastics division. He will be responsible for all operations in reinforced plastics, thermosetting molding, and Prolon custom molding. **Fred Grinnell** has been named general foreman of all injection molding departments.

Herbert Schoenfield has been appointed to the newly-created position of polyester sales manager for Witco Chemical Co's chemical sales division. Former technical service manager for Witco's Emulsol Chemical Corp., Mr. Schoenfield will maintain headquarters in Chicago, Ill.

New Materials

Write item numbers on Readers' Service Card to obtain more information.

Highly-Reactive Allyl Monomer

An allyl monomer which can be self-polymerized, or copolymerized with a wide variety of reactive monomers, has been introduced commercially by Food Machinery & Chemical Corp.'s recently-formed organic chemicals division. Chemically, the material is methallyl chloride (3-chloro-2-methyl-1-propene), and is characterized by the presence of two highly-reactive centers in the molecule.

The chlorine atom is capable of undergoing hydrolysis, etherification, or caustic oxidation, and can be reacted with ammonia, amines, inorganic salts, methylene compounds, and metals. The double bond can undergo hydration, isomerization, halogenation, nitration, sulfonation, oxidation, carboxylation, or in the Friedel-Crafts reaction, and can be reacted with hydrogen halides.

Physical properties are listed as follows:

Color	Water-white to straw
Purity, min. %	95
Specific gravity	0.926-0.93
Free acid content, max. %	0.1
Weight per gallon, lbs.	7.7-7.74
Molecular weight	90.55
Boiling point, °C	72.2
Freezing point, °C	—80
Refractive index	1.4276
Specific gravity	0.9257
Flash point, Tag open cup, °F	14
Solubility in organic solvents	Miscible
In water, wt. %	0.1

Readers' Service Item M-1

VANSTAY Z

zinc bearing chelator for PVC resins imparts outstanding clarity, stability and resistance to sulfur staining when used as recommended with other VANSTAYS in many vinyl products.

Plastisols, Organosols, Extruded Goods

Use 1.5 VANSTAY R with .5 VANSTAY Z for maximum resistance to process heat and good service life.

Film, Sheeting, Molded Products

Use 1—1.5 VANSTAY HT with .5—1.5 VANSTAY Z to obtain the required protection.

When Roll plating is a problem:

Use 1.5 VANSTAY N with 1.5 VANSTAY Z as the stabilizing system.

Our Technical Service Representatives will gladly demonstrate the merits of our materials in your plant and assist in solving production problems.

Oliver

R. T. Vanderbilt Co., INC.
230 PARK AVENUE, NEW YORK 17, N. Y.

Two Epoxy Coating Resins

Two new coating resins have been added to Marblette Corp.'s Maraset epoxy line. Designated Maraset grey enamel #750 and clear varnish #V-760, the materials are flexible, yet highly abrasion-resistant. They are intended for both indoor and outdoor use.

The enamel protects piping and equipment from the corrosive action of fumes, fuels, and fluids. In latex dipping, it smoothes the finish of aluminum pattern duplicates and prevents the development of pits and fissures. The varnish offers the added advantage of transparency, and can be used to make bricks and plaster waterproof. It also imparts longer life to plaster molds and patterns.

Both are supplied with catalyzed thinners, and are cured at room temperature. Standard brush or spray techniques can be employed. Physical data follow:

	V-760	750
Weight, lbs./gal.	7.7	8.66-9
Total solids, %	32	57.6
Coverage, sq. ft./gal.	600	500
Hardness, Sward	50	50
Flexibility	Excellent	Good
Impact resistance	Excellent	
Outdoor durability	Very good	Excellent
Abrasive resistance	Good	Good
Caustic resistance	Very good	Very good
Acid resistance	Very good	Very good

Readers' Service Item M-2

Rubber-Modified Polystyrene

A heat-resistant, rubber-modified, polystyrene molding compound in pellet form is available from Bakelite Co. Designated TMD-5161, it features a heat-distortion point of 190-195° F., low bulk factor, and improved flexural strength.

The cylindrical pellets are 0.1-inch in diameter by 0.1-inch in length, and are externally lubricated. TMD-5161's combination of properties make it particularly useful in the molding of electrical appliance housings, especially portable radio cases. A listing of physical properties follows:

Bulk factor	1.72
Mold shrinkage, in./in.	0.004
Specific gravity, natural	1.04
Colors	1.03-1.08
Hardness, Rockwell "L"	78
Water absorption, 24-hr. water immersion, % wt. gain	0.14
Impact strength, Izod, ⅛ x ½ x 2½-in. notched bar, ft. lbs./in.	2.6
Compressive yield strength, ½ x ½ x 1-in. bar, psi.	10,300
Tensile strength, ⅛-in. bar, psi.	6,700
Elongation in tension, %	5
Modulus of elasticity in tension, psi.	3×10^5
Flexural strength, ¼ x ½ x 5-in. bar, psi.	9,200
Modulus of elasticity in flexure, psi.	3.9×10^5
Dielectric strength, short time, volts/mil.	480
Volume resistivity, ohm-cm.	10^{14}
Dielectric constant, at 60, 10^3, 10^6 cycles	2.75
Dissipation factor, at 60, 10^3, 10^6 cycles	0.0015

Readers' Service Item M-3

Epoxy Casting Resin & Foam

A flexible, epoxide casting resin and a foam-in-place epoxy material have been introduced by Emerson & Cuming, Inc. The materials are designated Stycast 2741 and Eccofoam PT, respectively.

Stycast 2741 is supplied as two components which can be cured at room temperature. Since the cured material retains its flexibility at —70° F., it can be used for encapsulation, potting, and sealing applications requring low-temperature use. No harmful effects are found at temperatures in excess of 300° F.; shrinkage during cure is negligible; and adhesion to most materials is excellent.

Following are properties reported for Stycast 2741:

Pot life, catalyzed, hrs.	2
Color	Black
Hardness, Shore, 100 pts. resin to 100 pts. Catalyst 15	50
Using 100 pts. resin to 150 pts. catalyst	30
Specific gravity	1.2
Cure, room temperature, hrs.	8
At 70° C., hr.	0.5
Flexural strength, psi.	7,000
Flexural modulus, psi.	1.1×10^5
Impact strength, Izod, ft.lbs./in. notch	9
Dielectric strength, volts/mil	420
Volume resistivity, ohm-cm.	1×10^{14}
Dielectric constant, 100 cps.	3.2
At 10^6 cps.	3.05
At 10^9 cps.	2.9
Dissipation factor, 100 cps.	0.032
At 10^6 cps.	0.03
At 10^9 cps.	0.028

Eccofoam PT is one of a series of pack-in-place foams. Curable at room- or elevated temperatures, the foam is capable of continuous use at 300° F., and can

HARFLEX® 300

A NON-MIGRATORY PLASTICIZER

Migration tests run on samples of PVC plasticized with HARFLEX® 300 show no effect on polystyrene, or on varnish and alkyd enamel finishes. This permanent polymeric plasticizer has good compatibility and easy processing characteristics that eliminate the need for using secondary plasticizers as processing aids.

Manufacturers of plastic products or plastisols that must be extraction resistant will be interested in testing HARFLEX® 300. Samples of HARFLEX® 300 for test or experimental work are available by writing for our Technical Bulletin #1002-H which gives full information about this easy processing and efficient plasticizer.

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H-23

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is a pure dibasic acid
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withstand 350° F. for short periods. The foam is used as a potting compound, for sandwich structures, as a light-weight adhesive and caulking compound, and for thermal insulation. It is supplied in two components, each resembling damp sand. These are mixed and tamped in place within the cavity. Adhesion is good, and can be improved with a coating of Cement #55. Mold Release Compound 122S is used to prevent adhesion, if so desired. Sealants can be used since the foam is not completely unicellular.

Eccofoam PT is reported to possess the following properties:

Bulk density, lb./cu.ft.	20
Compressive strength, psi.	1,010
Flexural strength, psi.	800
Flexural modulus, psi.	54,000
Coefficient of thermal expansion, cm./cm./°C.	0.032
Thermal conductivity, Btu./hr./sq.ft./°F./ft.	40 x 10⁻⁶
Water absorption, 8 cu.in. sample, 24 hrs., % gain	1.4
Dielectric constant, 10²-10⁹ cps.	1.45
Dissipation factor, 10²-10⁹ cps.	0.01

Readers' Service Item M-4

Non-Woven Felt-Like Fabric

A felt-like fabric, made from almost infinite combinations of cardable fibers such as wool, rayon, cotton, Dynel, nylon, and Dacron, is available from Felters Co. Called AllFab, the material uses several types of thermoplastic binders: the most common being Bakelite's VYHH vinyl resin.

The binder offers two distinct advantages: AllFab can be heat-sealed either electronically or in regular fashion, and will hold any embossed pattern so that it actually gives a lasting dimension to the bonded material. Resin content varies from 15-45%, thickness from 1/16-2 inches, weight from ½-16 ounces, and width from 16-80 inches. Length of piece depends upon the weight.

Felters Co. uses an exclusive process to spray and fuse thermoplastic powder onto the fibers, and the combination can be used as a filler and backing material, in package design, as upholstery, or as disposable material. Colors are available within mix limits; however, AllFab cannot be dyed. Minimum production runs are 5,000 yards of any given type.

Readers' Service Item M-5

Thermoplastic Molding Powder

Property data are available on Delrin acetal resin, an experimental molding powder presently available in pilot-plant quantities from Du Pont's polychemicals department. The material is said to possess an excellent combination of properties, such as high tensile strength, toughness, high melting temperature, fatigue life, dimensional stability, solvent resistance, and resistance to deformation. It should be available on a fully-commercial basis by 1959.

Two compositions have been developed: Delrin 500X, a general-purpose resin for injection molding; and Delrin 150X, a general-purpose extrusion resin. The formulations are offered as ⅛ by ⅛-inch, cylindrical pellets in natural, white, or standard colors.

Delrins 500X and 150X differ in elongation and impact strength. The extrusion material has an elongation of 38% at —68° F.; 75% at 73° F.; and 460% at 158° F. Its Izod impact strengths at —40° and 73° F. are 1.8 and 2.3 foot-pounds per inch, respectively. Delrin 500X's elongation at —68, +73, and +158° F. is 13%, 15%, and 330%, respectively. Its Izod values at —40 and +73° F. are 1.2 and 1.4, respectively.

Other properties are the same for both formulations, and are quoted as follows:

Tensile strength, psi., @ –68°F.	14,700
At 73°F.	10,000
At 158°F.	7,500
Flexural modulus, psi., @ 73°F.	410,000
At 170°F.	190,000
At 250°F.	90,000
Flexural strength, psi.	14,100
Shear strength, psi.	9,510
Heat distortion point at 264 psi., °F.	212
At 66 psi., °F.	338
Fatigue endurance limit, 70°F., 50-100% relative humidity, psi.	5,000
At 150° F., 100% relative humidity, psi.	3,000
Water absorption, 24-hr. immersion, %	0.4
Specific gravity	1.425
Hardness, Rockwell "R"	120
Rockwell "M"	94
Flammability, in./min.	1.1
Creep in flexure, in./in./hr./73°F. @ 2,000 psi.	6 x 10⁻⁶
At 3,000 psi.	7 x 10⁻⁶
Melting point, °F.	347
Flow temperature, °F.	363
Deformation, 2,000 psi. @ 122°F., %	0.5
Compressive stress, 1% deformation, psi.	5,200
Coefficient of linear expansion per °F.	4.5 x 10⁻⁵
Abrasive resistance, Taber, 1,000 gm. load and CS-17 wheel, mg./1,000 cycles	20
Thermal conductivity, Btu./hr./sq.ft./°F./in.	1.6
Specific heat, cal./gm.	0.35

Readers' Service Item M-6

Plasticizer and Intermediate

Nonyl alcohol and dinonyl phthalate are available from Eastman Chemical Products, Inc., in tank-car quantities. The alcohol reacts with phthalic anhydride to form dinonyl phthalate, a plasticizer offering good retention and superior electrical properties in vinyl formulations. Nonyl alcohol develops very little color during esterification with dibasic acids.

Dinonyl phthalate is said to offer economy advantages over dioctyl phthalate, since larger quantities of the cheaper material can be used to achieve the same effects with vinyls. This is predicated on the fact that all plasticizer materials are cheaper than vinyl polymers.

Following are property data on nonyl alcohol:

Specific gravity	0.826-0.83
Boiling range, °C.	190-200
Color, APHA, max. ppm.	10
Aldehyde content as nonanal, %	0.7
Acidity as acetic acid, %	0.01
Unsaturation as nonenal, %	0.2
Sulfuric acid reflux color, APHA, max. ppm.	100
Phthalate test color, APHA, max. ppm.	100

Properties for dinonyl phthalate are reported as follows:

Color, APHA	25
After 2 hrs. at 220°C.	50
Acidity, as phthalic, %	0.01
As acetic, %	0.007
Ester content, %	99
Specific gravity	0.965-0.971
Odor	None
Molecular weight, theoretical	418
Refractive index	1.4812
Weight, lbs./gal.	8.08
Boiling point, °C.	314
Pour point, °C.	–22
Water solubility at 20°C., gms./liter	0.014
Evaporation rate at 100°C., gms./1,000 sq. cm./hr.	0.017
Flash point, Cleveland open cup, °F.	455
Fire point, °F.	485
Viscosity, cstks., at 25°C.	170
At 100°C.	4.65
Volume resistivity, ohm-cm.	3.2 x 10¹²
Dielectric constant at 1 mc.	4.3
Dissipation factor at 1 mc.	1.4

Readers' Service Item M-7

Form-Stable Nylon Formulation

A nylon resin combining exceptional form-stability in the molten stage with toughness and stiffness in the finished product has been introduced by E. I. du Pont de Nemours & Co., Inc. Called Zytel 42, the material's melt flow characteristics make it particularly well suited for both extrusion and blow molding.

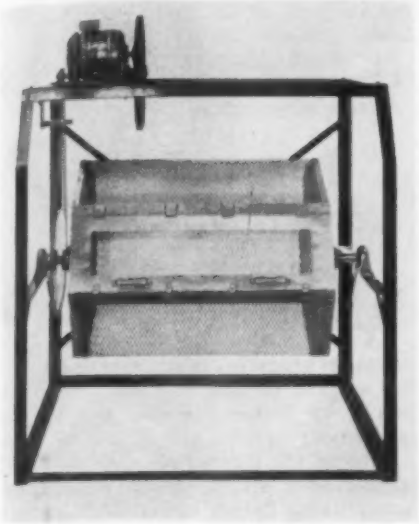
Other features claimed for the material are form stability at high temperatures, toughness over a wide range of temperatures, abrasion resistance, thin-section strength, lightness of weight, and chemical resistance. Physical properties are reported as follows:

Elongation @ 73° F., %	107-217
Impact strength, Izod, ft.lb./in.	1.1-1.5
Tensile strength, psi.	11,200-12,600
Modulus of elasticity, psi.	400,000
Shear strength, psi.	9,600
Stiffness, psi.	200,000
Flexural strength, psi.	13,800
Compressive strength, 1% deformation, psi.	4,900
Creep in flexure, std. load, deflection in mils	90
Hardness, Rockwell R	118
Flow temperature, °F.	480
Coefficient of linear expansion per °F.	5.5 x 10⁻⁵
Thermal conductivity, Btu./hr./sq. ft./°F./in.	1.7
Specific heat	0.4
Deformation under 2,000-psi. load @ 122° F., %	1.4
Heat distortion point, 66 psi., °F.	360
At 264 psi., °F.	150
Dielectric strength, volts/mil:	
Short-time	385
Step-by-step	340
Volume resistivity, ohm-cm.	4.5 x 10¹³
Dielectric constant, 60 cycles	4.1
At 10³ cycles	4
At 10⁶ cycles	3.4
Power factor, 60 cycles	0.014
At 10³ cycles	0.02
At 10⁶ cycles	0.04
Water absorption, %	1.5
Flammability, in./min.	Self-extinguishing
Specific gravity	1.14
Compression ratio	2.1

Readers' Service Item M-8

New Equipment

Write item numbers on Readers' Service Card to obtain more information.



Single-barrel unit for deflashing plastics.

Two Dry-Tumbling Units

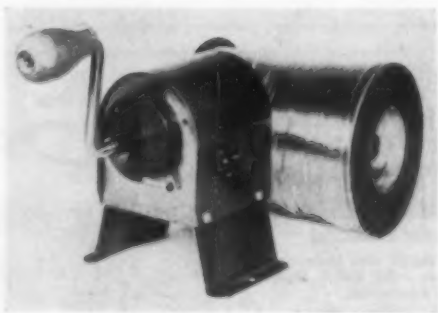
Two new items of tumbling equipment have been placed on the market by H. W. Kramer Co. Inc. One, designated the Screen Deflashing Barrel, is designed exclusively for deflashing plastic parts. The perforated, metal barrel has sufficiently large openings for the automatic removal of flash, and is driven by a ½-hp. motor. Light but sturdy, the frame does not require bolting to the floor. The standard barrel is 30 inches in diameter, and is 36 inches long.

The Dry-Tumbling Double-Barrel Machine is intended primarily as a space saver. The barrels have two compartments; a sheet metal skin; and a replaceable, hard-maple lining. Octagonal in shape, the barrels are available in the following sizes: 30 by 42 inches, 30 by 36 inches, and 20 by 24 inches. A set of solid doors and a set of screen doors are supplied with each barrel.

The double-barrel unit is equipped with a 2½-hp. motor and countershaft. The latter is mounted on ball-bearing pillow blocks. The chain-operated drive operates at 28 revolutions per minute, and is relatively quiet at this speed. A peg catch pan and separating screen are available.

Readers' Service Item E-1

Double-barrel tumbling unit.



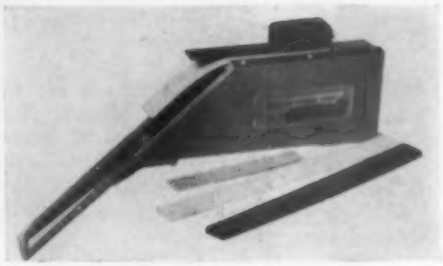
Little Joe compact sleeving cutter.

Bench-Type Sleeving Cutter

A bench-type sleeving cutter for all types of insulation tubing up to ¼-inch diameter has been introduced by Macdonald & Co. Called Little Joe, the cutter turns out as many as 10,000 pieces per hour by the hand-crank method. It is designed to take a 1/15-hp. motor, should automatic operation be desired.

Length ranging from 1/32-2 inches can be turned out, including fibrous glass- and silicon-coated nylon, small wire, and solder. All moving parts are of case-hardened steel, and the high-speed steel knife is removed easily for resharpening or replacement. Little Joe measures five by 5½ by six inches, and weighs six pounds.

Readers' Service Item E-2



Stiffness tester for plastic foams.

Thick-Sheet Stiffness Tester

A new stiffness tester for extra-thick sheet materials, such as felt, carpeting, batting, sponge rubber, and plastic foam, has been developed by Fabric Development Tests, Inc. Designated the Model-X Drape-Flex Stiffness Tester, the unit conforms to Federal Test Method 5206 and ASTM Method D1388-55T preferred cantilever test. Total weight is five pounds.

The new tester can be used with materials of any thickness from ⅛-2 inches, and in strip lengths up to 14 inches. Improvements over the standard tester include the relocation of reference-angle slope supports and leveling screw so that they would not interfere with the measurement of thick materials requiring the use of a slope extension.

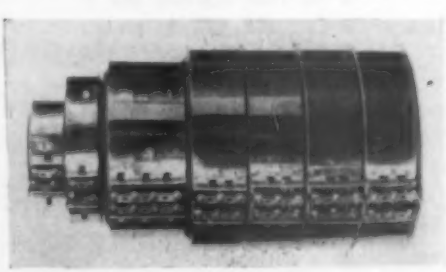
In operation, the stand is supported in a horizontal position. Specimens, die-cut with the test direction in the length, are picked up by the hand grip. The clamp depressor control-pin locks the specimen in place on the specimen holder, which is mounted on the top surface of the stand. It is moved forward until the free end of the specimen drops down under its own weight to the level of the standard slope. The length of overhanging is read directly from the fixed scale opposite the reference mark on the movable holder.

Readers' Service Item E-3

Replacement Heater Bands

A new type of replacement heater bands, called Thermastrips, have been developed by Thermel, Inc. They feature full-circle heating, using aluminum shoes to store up the heat supplied by the tubular elements, and thus eliminate the heat lag found in older bands

Thermastrip Bands have extra high wat-



Thermastrip heater bands for injection cylinders.

tage, and are designed expressly for the injection machine heating cylinder. They are supplied in diameters of 4-18 inches, and in widths of 1½-2½ inches. Delivery is offered in 4-7 days, with 24-48 hour emergency service available at a slightly extra charge.

Readers' Service Item E-4

Bumping & Timing Controller

A flexible, quickly-set controller for the precise operation of a hydraulic press requiring bumping and timing control has been introduced by Emmett Machine & Mfg., Inc. Designated the Type E-364 Robotron, the portable unit operates on the principle of pushbutton-cycle setup.

The Robotron closes the press; bumps as required to degas the mold cavity; holds the press closed during cure; and, finally, opens the press for the next cycle. A set of 24 pushbuttons, each representing ⅛-minute, makes bumping controllable over a three-minute period. A dial-set timer with a range of ¼-15 seconds controls the amount of press opening during bumping. The 27-point selector switch determines the time, which added to the three-minute bumping period, makes up the over-all cycle.

Robotron hydraulic-press controller.

A selector switch gives the above-mentioned 27 extra time steps optional values of ¼ or ½ minute, thus permitting a longer range of cycles. Other controls include a reset pushbutton, a fuse, and a manual automatic switch. With the cover closed, the operator has access only to the external pushbutton and the manual open/close switch.

The starting pushbutton locks-up a relay which supplies current to the solenoid valve. It also starts a timing motor which turns a contact arm across a number of contacts to start a time pulse every ⅛, ¼, or ½ minute. Each time pulse advances a stepping switch one position. The first 24 stepping-switch contacts are wired consecutively to the bump pushbuttons, while the next 27 stepping-switch contacts are wired consecutively to the points of the selector switch.

A closed circuit at any of the pushbuttons will cause the solenoid-valve feed to open, thereby starting the bump-measuring timer. When the time runs out, the circuit is reclosed to the solenoid valve and the press closes. The selector switch provides a closed circuit at a selected time, releases the main relay, and resets the control. The case is 10 inches wide, 12 inches high, and four inches deep. Assembled weight is 22 pounds.

Readers' Service tem E-5

Particle Size Test Unit

A re-designed Sub-Sieve Sizer, universally used for routine determinations of average particle size, has been introduced by Fisher Scientific Co. The improvement consists of a unique clamp assembly for the sample tube utilizing a simple lever action, instead of the more-complicated thumb screw. The tube containing the packed sample is slipped in place at the front of the instrument, and clamped to form an air-tight seal.

NEW 3 STAGE Vacuum Forming Machine Comet "Rotary-Vac"

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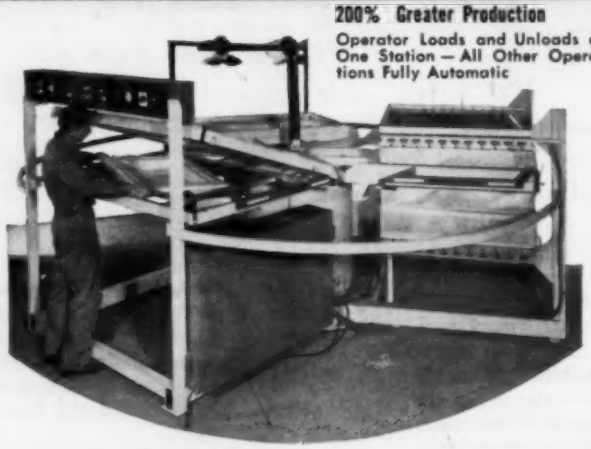

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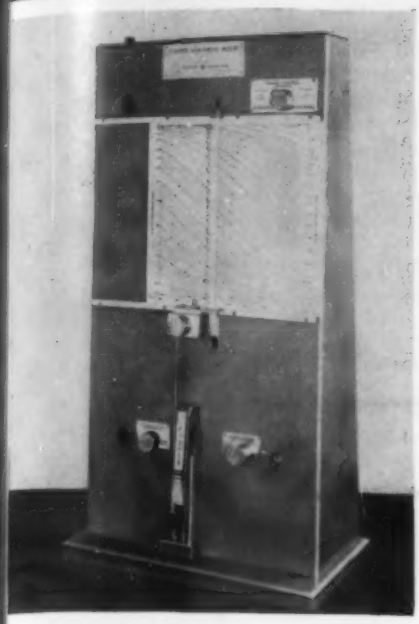


Apparatus for determining the average size of sub-sieve particles.

Laboratories using earlier-type Sizers can obtain the new clamp assembly in an easily-installed, do-it-yourself kit. The new model includes improved controls for pressure and air flow, plus a gray-enamel finish. It operates on 115-volts, 50-60 megacycles, A.C. current.

For those not familiar with the Sub-Sieve Sizer, it operates on the principle that the coarseness or fineness of uniformly-packed powder controls its resistance to the flow of dry air. The theoretical equation for average particle diameter, in microns, involves eight variables. The sizer standardizes test conditions and, through the use of a copyrighted calculator chart which eliminates the need for mathematical computations.

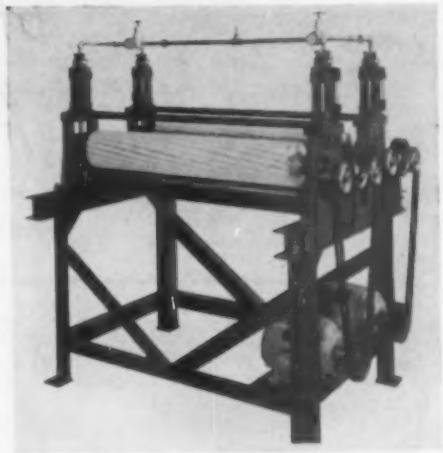
The motor-driven air pump builds up pressure in the regulator so that a uniform flow of dry air passes through the tightly-packed column of plastic or other particles. A double-range meter measures air flow, and the liquid level of the manometer varies with particle resistance. Average particle size is read in microns, directly from the chart. The apparatus covers two ranges: 0.2-20 microns, and 20-50 microns.

Readers' Service Item E-6

Mechanical Brushing Machine

A dual-purpose brushing machine for imparting surface luster to a continuous web of plastic material, and for brushing conveyor belts while in operation, has been introduced by Fuller Brush Co. The unit also improves the finish of plastic floor tile at the rate of 25 feet per minute.

The machine has a 44-inch width capacity, and is equipped with two rotating horsehair brushes of Fullergript brush strips. Air cylinders, operating by remote control, are mounted on top of the machine for lifting the brushes from the plastic surface. Other features include push-button controls, handwheel adjustments to compensate for different thickness wear, and hoods which can be connected to the plant's exhaust system.

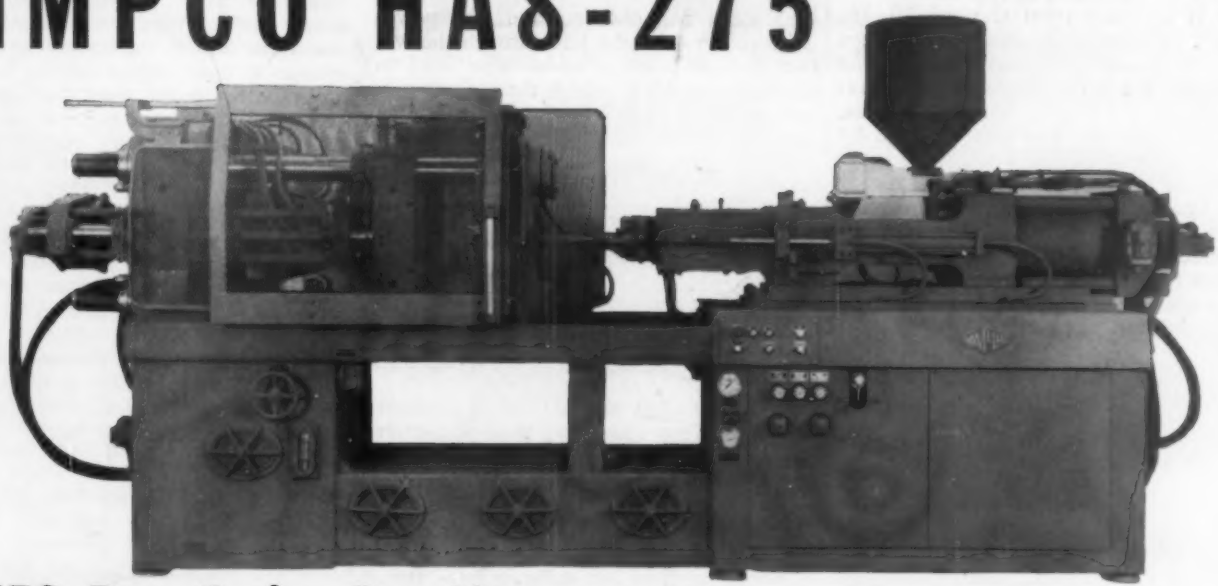


W. P. Muller & Co.

Machine for imparting surface luster to plastics.

Readers' Service Item E-7

IMPCO HA8-275



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New Products

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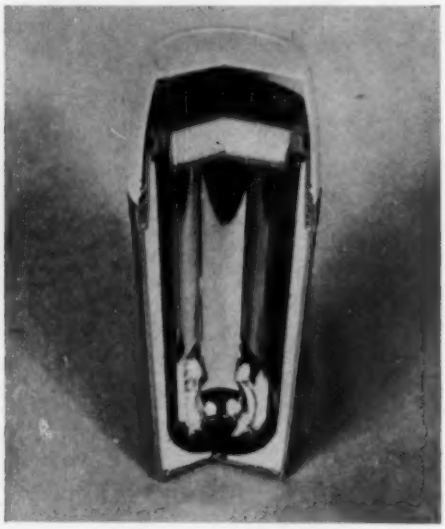

Cut-a-way view of all-plastic thermos shows urethane foam insulation.

All-Plastic Vacuum Bottle

A break-proof, all-plastic thermos bottle which will keep foods hot or cold for six hours is available from General Molded Plastics, Inc. Called Durovac, the thermos features a plastic inner liner, permanently sealed inside a polyethylene case. The insulation material is made of urethane foam, basic chemicals for which are supplied by E. I. du Pont de Nemours & Co., Inc.

Durovac is easily washed with soap or detergent. The permanent seal prevents liquids from getting between the outer case and inner liner. Use of plastics assures freedom from rust and odors. The vacuum bottles are available in red or blue colors, in pint and half-pint sizes.

Readers' Service Item P-1

Reinforced-epoxy hydrofoils furnish both lift and strength.

Retractable Epoxy Hydrofoils

Retractable hydrofoils, which will lift a 15½-foot outboard motor boat above the water at 15 miles per hour, have been introduced by Dynamic Developments, Inc. Made from Bakelite's epoxy resins with a reinforcement of glass-fiber cloth, the hydrofoils can carry a total load of 1,360 pounds at 30 miles per hour.

The first boat to be so equipped is the aluminum-hulled Grumman Runabout, a product of Grumman Boats, Inc. Two main foils are attached to the hull on either side of the driver's seat by means of a special hinge and lock. The locking handle is twisted and pulled to swing the hydrofoils into a fully retracted position above the hull. This enables the boat to be transported easily on land.

The three-foot tail foil is also retracted from its position behind the 30-hp outboard motor. The propellor shaft is five inches longer than standard. A shear pin on the hinge of the forward hydrofoils allows one or both to break away if they strike a solid object in the water. Since the foils are made with wooden and/or hollow cores, they will float until recovered.

At a speed of 30 miles per hour, the hydrofoils require about half the power required to drive the hull through the water. Bakelite's epoxy resins were used to make the molds in which the earliest prototypes were cast in order to save time and production costs.

Readers' Service Item P-2

Plastisol-Coated Marine Items

A line of vinyl plastisol-coated products for the marine trade have been placed on the market by Whitman & Robinson. Designated Nomar, the line includes anchors, boat hooks, gasoline tank holders, and battery boxes. Primers and plastisols are provided by Stanley Chemical Co.

Nomar anchors are made in five-, ten-, and 15-pound weights to handle anything from a rowboat to a 22-foot cruiser. They will not mar the highly-finished decks of boats, nor will they slip or pick up motor vibrations.

W & R reports the best coating system to consist of Stanley 72R-426A primer containing zinc chromate, plus a coat of Stanley 77X-1078 orange plastisol. The coated anchor is impervious to salt and oxygen deterioration, it is claimed, and will wash clean when pulled from a muddy bottom.

Nomar vinyl plastisol-coated anchor.

Readers' Service Item P-3

Plastic Gasket & Shim Stock

Plastic gasket and shim stock, color-coded to indicate 12 different thicknesses, has been introduced by General Gasket Co. Called Color-Plast Gasket and Shim Stock, the thermoplastic material is processed to hold its gage at micrometer tolerances. It is reportedly tougher and longer lasting than conventional sealing materials, and is impervious to oils and greases at their boiling points.

Available gages and their respective colors are as follows: one mil, amber; 1½ mils, purple; two mils, red; three mils, green; five mils, blue; 7½ mils, trans matte; 10 mils, brown; 12½ mils, black; 15 mils, pink; 20 mils, yellow; 25 mils, solid white; and 30 mils, coral. Resiliency of the material makes the use of gasket cement unnecessary. In some instances it serves as shim, gasket, and sealer.

Color-Plast can be obtained in roll or sheet form, cut to customer specifications. It is also available as die-cut shims for cup and cone adjusted tapered roller bearings. Color-Plast is easily cut with hand tools.

Readers' Service Item P-4

Three Epoxide Pastes

Three epoxy pastes and their respective, non-dermatitic hardeners have been introduced by Furane Plastics, Inc. They are steel-filled Epocast 154, aluminum-filled Epocast 152, and mineral-filled Epocast 150.

Epocast 150 is a cold-setting, thixotropic paste with outstanding adhesion to wood,

metal, and concrete. Exactly 100 parts by weight are mixed with 40 parts by weight of hardener 947, and the ensuing compound has a pot life of approximately 10-15 minutes. The material is tack free in 1-2 hours, can be machined or sanded after 10 hours, and achieves full strength after 48 hours. Heat cure is recommended wherever practical. A cream-colored surface up to ½-inch thick can be built up without sag on vertical walls. Shrinkage is negligible.

Epocast 152 is a bright, metallic-like, semi-paste material designed to replace lead solder in auto repair shops for patching, filling, and splining applications. It reportedly offers greater economies, quicker build-up, ease of handling, and safety. The mixture calls for 100 parts by weight of the resin, and 40 parts by weight of hardener 984. Pot life, tack-free time, and room-temperature cure are approximately the same as those for Epocast 152. A heat cure with an infra-red lamp is recommended.

Epocast 154 lends itself to industrial applications requiring a tough, low-shrinkage, adhesive patching compound. Steel colored, the cured compound machines readily after 6-10 hours. The proportion, by weight, of resin to hardener 947 is 100:10. Pot life is approximately 40 minutes at room temperature, and a heat cure at 150° F. for 1-3 hours is recommended.

Readers' Service Item P-5

Inflatable Vinyl Boat

A two-man vinyl boat designed to accommodate an outboard motor has been developed by Davis Products, Inc. Called the Outboardsman, the boat employs two, independently-inflatable tubes of General Tire & Rubber Co.'s Boltaflex vinyl plastic.

The boat is equipped with a built-in wooden seat and motor attachment, the latter accommodating any standard outboard motor up through three hp. Another feature permits the insertion of a standard air mattress, and both lifeline and sea anchor are included as standard equipment.

Deflated, the Outboardsman weighs 17 pounds and the outboard attachment weighs 13 pounds. It folds into a compact unit which fits neatly into any car trunk.

Two-man, inflatable vinyl boat.

Inflated dimensions are eight by 4½ feet, by 15 inches deep. Blue in color, the boat has withstood extensive testing in the rough waters of the Pacific.

Readers' Service Item P-6

Corrosion-resistant plastic tanks.

Corrosion-Resistant Tank Line

A line of standard-sized plastic tanks, engineered to rapid production and fast delivery, has been introduced by Haveg Industries, Inc. Molded in one-piece without seams or joints, the tanks can be erected in the field. Chemical resistance is not merely a surface condition, but exists throughout the entire mass of the material.

A wide variety of sizes and shapes are available, usually within 4-5 days after receipt of the order. Capacities range from 10-10,000 gallons, and corrosion resistance is claimed against most acids and salts.

Readers' Service Item P-7

Fire-Resistant Thermoplastic

A fire-resistant thermoplastic sheet material which can be vacuum-or drape-formed has been introduced by Charles Crowl Co. Ellay Rubber Co. assisted in the development of the material, which is called Fireban.

A combination of styrene and vinyl resins, Fireban uses no fillers or other flame-suppressants. No sacrifice is made at either end of the temperature range to obtain maximum impact values, and the same brilliant colors associated with vinyls are obtainable with Fireban. Well-defined, deep draws are possible, and lighter-than-normal gages reportedly can be used due to the material's high tensile strength.

Properties are listed as follows:

Specific gravity	1.2
Tensile strength, psi.	4,800
Stiffness modulus, Olsen	425
Thermal distortion point, °F.	174
Elongation, %	95

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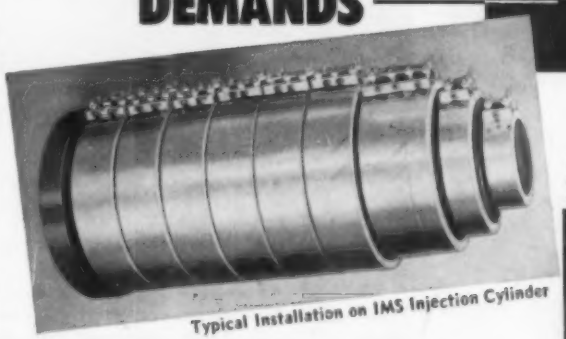

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Thermastrip Bands showing details of construction, including grooved aluminum shoe and tubular elements.

- **Full Circle Heating — No Cold Spots.**
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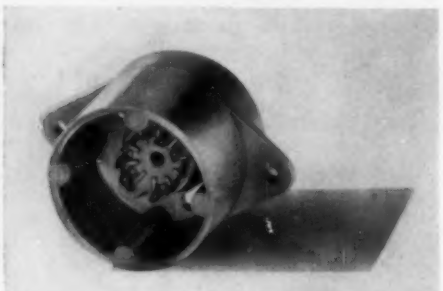
Fireban is produced in a wide variety of colors, and in all standard gages from 1/32-1/4 inch. Finishes include Colonial, Hair Cell, sand blast, and smooth. Among the applications for the sheeting are air-conditioner housings, truck-trailer liners, decorative overlays, contour packaging, luggage, and handbags.

Readers' Service Item P-8



Molded urea socket insulates against high corona.

Urea Electronic-Tube Socket

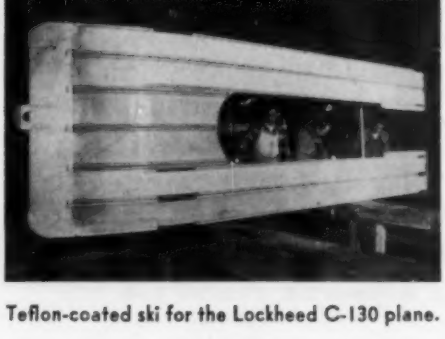
A nine-pin electronic tube socket of full-molded, white urea has been developed by Sylvania Electric Products, Inc. The miniature socket is designed to protect against high-voltage corona in such equipment as portable television receivers.

Over-all height of the socket is 1 11/16 inches, and the body diameter is 1¾ inches. Contacts are of cadmium-plated brass, and provision is made for the ready insertion of a shield ring or center shield. A deep, reinforced skirt or well extends beyond the terminals to afford added protection. The socket can be mounted on the top or bottom of a chassis.

Readers' Service Item P-9

Fluorocarbon Ski Coverings

A thin film of Teflon, Du Pont's tetrafluoroethylene resin, is being used to cover the bottoms of the largest aircraft skis ever made. Designed to reduce the friction of bare metal on snow by 50%, the Teflon skin is being tested on Lockheed's C-130 polar troop carrier.



Teflon-coated ski for the Lockheed C-130 plane.

Lockheed engineers have designed a three-part undercarriage. The main load is distributed between two skis, which are approximately 19 feet long and five feet wide. The nose ski, used to steer the plane on the ground, is about nine feet long and five feet wide. Sheets of Teflon, 3/32-inch thick, were treated on one side with sodium-ammonia to produce a cementable surface.

After bonding the skin to the ski with an epoxy adhesive, the runners were mounted on the outer surface with mechanical fasteners. More than 190 pounds of Teflon are required to cover the undercarriage of a single C-130 aircraft. U. S. Gasket Co., formed the sheet and prepared its surface.

Readers' Service Item P-10

Polystyrene Light Shields

An extruded polystyrene diffuser for fluorescent light fixtures, which combines a reflection-free surface with extreme flexibility and impact strength, has been developed by Sheffield Plastics, Inc. Called Frost-White, the shields incorporate an ultraviolet-light absorber within the polystyrene formulation.

Burns Photography, Inc.

Frost-White styrene shields demonstrate whiteness and flexibility.

Flexural and impact strength are derived from the combination of styrene resins developed by Sheffield engineers, and their non-reflecting surface finish is the result of special manufacturing technique. The shields are said to sacrifice no heat resistance, cold flow, or dimensional stability, despite their unusual properties.

Specification data are reported as follows:

Specific gravity	1.05
Tensile strength, psi.	6,500
Impact strength, ft. lbs./in.	0.4-0.5
Elongation at break, %	10-12
Thermal expansion, in./in./°C	
Heat distortion point, °F	178-186
Light transmission, white translucent colors, %	1-60
Color possibilities	Unlimited
Burning rate, in./min.	1
Light stability, hours	20,000

Readers' Service Item P-11

Polyurethane foam pads Western saddle.

Polyurethane Foam Materials

A complete line of polyurethane-foam rolls, sheets, and slabs in thicknesses from 1/8-12 inches, and in widths to 48 inches, has been introduced by Texas Foamed Plastics Corp. Called Gemfoam, the material is manufactured under a Du Pont license in 10 resiliencies and seven basic colors.

Texas Foamed Plastics Corp. offers the services of its production laboratory for assistance in the design and engineering of product applications. One such development is the 9½-pound Swan-Soft Saddle, shown in the accompanying photograph. This particular saddle uses Gemfoam cushioning, nylon reinforcements, and spring-steel saddle trees.

Readers' Service Item P-12

Calendered Polyethylene Films

A series of six, calendered, linear-polyethylene films made by the low-pressure method have added to Kendall Co.'s Polyken line. The new films offer greater heat resistance, lower gas permeability, and improved chemical resistance over standard polyethylene films.

Available gages range from 0.004-0.025 inch, and widths up to 32 inches can be obtained. The new line is limited to natural and black colors, and includes 100% linear materials, as well as blends of linear and standard materials. The latter offer some of the physical advantages of the linear polyethylenes, plus greater flexibility, improved handling, and greater yield per pound.

Readers' Service Item P-13

New Literature

Write item numbers on Readers' Service card to obtain copies.

"12906 — An Improved Impact - Type Black Phenolic Molding Compound." General Electric Co., chemical materials department. 4 pages. Cure speed, finish, pourability, and performance are described in this bulletin. Powder and molded properties are tabulated.

Readers' Service Item L-1

"Werner Uni-Molded Polyethylene Containers." Werner Mfg. Co. 4 pages. Descriptions and dimensions are given for the firm's line of sewn and heat-sealed polyethylene containers.

Readers' Service Item L-2

"Wall Chart of Conversion Factors." Precision Equipment Co. 1 page. This reference table lists such common conversions as inches to centimeters, watts to hp., microns to meters, and quintal to pounds, plus many other factors.

Readers' Service Item L-3

"Fundamentals of Thermoplastic Extrusion." Product Information Bulletin No. 1029. Monsanto Chemical Co., plastics division. 32 pages. This comprehensive, illustrated manual contains both practical and theoretical discussions of the extrusion process. Equipment considered includes the screw, the extruder, the die, and the post-extrusion parts. Treated separately are material on melt extrusion, the isothermal theory, the adiabatic theory, screw and die characteristic curves, and major factors affecting them. A two-page bibliography is included.

Readers' Service Item L-4

"Cut Faster, Clear Chips Better with New DME End Mills." Detroit Mold Engineering Co. 4 pages. Specifications and dimensions are given for the firm's two- and four-flute, single- and double-end mills, together with speed and feed data.

Readers' Service Item L-5

"Kralastic Extrusion." E. J. Trunk. Bulletin No. 1. Naugatuck Chemical, division of United States Rubber Co. 16 pages. This illustrated booklet describes the equipment required, the production process, and the average production rates for various dimensions of the copolymer pipe. The material's properties are illustrated by graphs.

Readers' Service Item L-6

"Aceto Products List." Aceto Chemical Co., Inc. 4 pages. Over 200 fine chemicals, intermediates, and industrial chemicals are listed and classified according to dyestuffs, textile, plastic, paint, electroplating, rubber, and other end uses.

Readers' Service Item L-7

"IMS Heating Cylinder Accessories." Injection Molders Supply Co. 24 pages. This illustrated booklet discusses features of all heater bands offered to the injection molder. Stock sizes are listed for 800 IMS heating cylinders now in use, and special order forms are included for description of other-type cylinders.

Readers' Service Item L-8

"R. D. Wood Platens—The Perfect Working Surface for Processing Plastics, Wood Products, and Rubber." R. D. Wood Co. 4 pages. This bulletin offers information on platen selection, including surface finish grades, degrees of surface parallelism, and size ranges. Cut-away drawings show the internal construction of four types of electrically-heated and steam-heated models.

Readers' Service Item L-9

"Alpha-Pinene Oxide." Bulletin No. 82. Becco Chemical division, Food Machinery & Chemical Corp. 8 pages. This material combines the reactivity of an epoxy group with that of the bicyclic system of alpha-pinene. It is used as an intermediate in organic synthesis, for solvents, plasticizers, protective coatings, lubricants, and adhesives.

Readers' Service Item L-10

"Dipentene Monoxide." Bulletin No. 81. Becco Chemical division, Food Machinery & Chemical Corp. 7 pages. This material combines the reactivity of an epoxy group with that of an olefinic double bond in a cyclic terpene molecule. It undergoes the usual reactions of the epoxy group and the external bond of the terpene molecule.

Readers' Service Item L-11

"High Pressure Hydraulic Valves." R. D. Wood Co. 8 pages. This two-color brochure catalogs 24 different valves for hydraulic systems, ranging in pressures from 1,500-20,000 psi. Sizes, constructions, and illustrations are included.

Readers' Service Item L-12

"IMS Report on Spreaderless Heaters." Injection Molders Supply Co. 7 pages. An up-to-date report on Melt Extraction and Polyliner-type injection heating chambers, covering advantages, disadvantages, and costs for each type.

Readers' Service Item L-13

"Stan-Tone Paste Colors." Bulletin #02-177-5-12-56. Harwick Standard Chemical Co. 2 pages. Properties, shipping data, and related information are given for the line of selected inorganic and organic pigments dispersed or flushed in a plasticizer to produce uniform, easy-working, smooth pastes.

Readers' Service Item L-14

"Teflon." Bulletin T-50. Haveg Industries, Inc. 4 pages. Teflon material, as it applies to Haveg equipment, is discussed. Property data is given in detail, together with information on its use in tubing and rod, steel pipe lining, insulated wire, machine parts, and sheet.

Readers' Service Item L-15

"Moly-Sulfide as a Filler." Bulletin Lu-12. Climax Molybdenum Co. 4 pages. The uses of the powder as a filler in nylon, phenolic laminates, Teflon, and other plastics are described, and properties of filled products and the powder itself are given.

Readers' Service Item L-16

"Durez 13124 Black." Durez Plastics Div., Hooker Electrochemical Co. 4 pages. Comprehensive property data on the phenolic molding compound are given, together with information on preforming, preheating, mold temperature, curing time, polishing and buffing, and shelf-like.

Readers' Service Item L-17

"R/M Asbestos Products for Reinforced Plastics." Bulletin No. T-56. Raybestos-Manhattan, Inc. 20 pages. Engineering data are given on the company's asbestos fibers, Pyrotex products, and asbestos cloths and yarns. Information presented includes properties, fabrication data, and fabricated end-uses.

Readers' Service Item L-18

"1957 Guide to Dow Corning Silicone Products." Reference No. 1-112. Dow Corning Corp. 12 pages. This year's edition of the "Guide" briefly describes the company's silicone compressible fluids, polishing agents, damping media, transducer fluid, heat-transfer media, cosmetic ingredients, diffusion pump fluids, lubricants, release agents, adhesives, defoamers, coatings, paint additives, water repellents, laminating resins, foaming powders, molding compound, rubber and guns, dielectrics, and fiber finishes.

Readers' Service Item L-19

"Epoxy Fatty Acid Ester Plasticizers, Preparation and Properties." Bulletin No. 80. Becco Chemical Div., Food Machinery & Chemical Corp. 4 pages. Methods of preparation and properties of several different plasticizers, prepared from unsaturated fatty acid esters by epoxidation reactions, are presented.

Readers' Service Item L-20

"Color-Plast Gasket and Shim Stock." General Gasket, Inc. 4 pages. Styles and dimensions of the color-coded gaskets, shims, spacers, and washers are listed, together with the advantages in time and labor saving of the products, and applications.

Readers' Service Item L-21

"Diall." Mesa Plastics Co. 8 pages. A brochure on the firm's six diallyl phthalate molding compounds, covering their properties, processing characteristics, and applications.

Readers' Service Item L-22

"Columbian Colloidal Dispersions for Aqueous Systems." Columbian Carbon Co. 10 pages. The company's line of Aquablaks, Hiblaks, and Colloidex materials, their properties and applications, are described. The materials are used to improve such products as paint, ink, paper, rubber, cement, and others.

Readers' Service Item L-23

"Fralastic Extrusion." By E. J. Trunk. Bulletin No. 1. Naugatuck Chemical Division, United States Rubber Co. 16 pages. Extruder screw designs, dies and pins, screens, take-away and cut-off equipment, operating temperature, production rates, and pipe properties and data are discussed. A trouble-shooting guide for correcting the common problems encountered in pipe extrusion is given, and there is a general description of the growth of Kralastic material.

Readers' Service Item L-24

"Ace Acrylic Rods, Tubes, and Shapes." Ace Plastic Co. 4 pages. The wide range of rods, tubes, and shapes stocked by the firm are described and illustrated. Applications for these products also are shown, and complete tables of properties of the material are included.

Readers' Service Item L-25

"Krane Brand Cast Vinyl Film." Bakelite Co. 20 pages. The clarity and toughness of tht film is demonstrated by an insert leaf specimen, and the uses and properties of the film are described in detail. Technical data are given on chemical resistance, tear strength, sealing, sewing, and printing, and spectrophotometric curves and graphs present evidence of the clarity, and imperviousness to moisture vapor and common gases of the film.

Readers' Service Item L-26

"Care and Feeding of Rubber Rolls." Report No. 11. Rodney Hunt Machine Co. 2 pages. Causes and recommended corrective treatments for faults commonly found in rubber rolls are discussed. Maintenance procedures also are covered, including cleaning, lubrication, transportation, and storage.

Readers' Service Item L-27

"Eliminating Static in Industry." Bulletin L/A 2778. United States Radium Corp. 2 pages. The causes and effects of industrial static electricity are described, and information is given on the use of the company's Ionotron for eliminating static. Industrial applications include textiles, plastics packaging, folding, coating and cloth printing, and others.

Readers' Service Item L-28

"Methylene Chloride." Dow Chemical Co. 24 pages. Specifications and property data are given for the chemical, together with handling information, and safety considerations. Applications for the solvent include vapor degreasing, paint and varnish removing, and cold cleaning and extraction processes.

Readers' Service Item L-29

"Dylex Latex K-52." Technical Bulletin C-6-239T. Chemical Div., Koppers Co., Inc. 16 pages. Comprehensive data are given on the firm's fortified styrene-butadiene copolymer latex for paper coating. and covering properties of the latex and coatings, application of coatings, and composition and effects of constituents.

Readers' Service Item L-30

"1957 Edition, Physical Properties of Carbide and Carbon Chemicals." Carbide & Carbon Chemicals Co. 26 pages. Information is given on the properties, handling, and applications of the company's acids, alcohols, esters, aldehydes, aryl and pyridine-type compounds, aliphatic nitrogen compounds, glycols, plasticizers, and others.

Readers' Service Item L-31

"Irrathene Irradiated Polyethylene Insulating Tape." General Electric Co. 12 pages. This handsome bulletin describes and illustrates the grades, available forms, properties, and uses of the material, with emphasis on its use in insulation systems.

Readers' Service Item L-32

"1957 Condensed Reference File, Bakelite Plastics." Bakelite Co. 16 pages. This 1957 edition of the CRF offers background data on the various plastics (polyethylenes, vinyls, phenolics, styrene, epoxies, and polyesters), brief discussions of the distinguishing characteristics of these materials, and illustrated information on applications that show good utilization of the materials.

Readers' Service Item L-33

"Logo Color Concentrate." Logo, Inc. 2 pages. The specification, uses, standard colors, and application by silk screening or roller coating of the RV-300 color concentrate are discussed.

Readers' Service Item L-34

"Dimethylaminoethyl Methacrylate." Rohm & Haas Co. 6 pages. This technical bulletin covers the physical properties, toxicity, composition, and polymerization of the monomer, its copolymerization with other monomers, and its fields of application.

Readers' Service Item L-35

"A Check List for Trouble Shooting Polyethylene Injection Molding Problems." Technical Service Bulletin 2-57. Chemical Div., Koppers Co., Inc. 12 pages. This is a handy check-list for machine operators and plant superintendents that lists and discusses various difficulties that may arise during molding, and the corrections required to alleviate these difficulties.

Readers' Service Item L-36

"Taylor-Stiles Series 700 Multiple Knife Cutters." Index No. App. 210. Taylor, Stiles & Co. 4 pages. This illustrated bulletin covers the construction and operation features of the machines, and their sizes and applications.

Readers' Service Item L-37

"'Teflon' Lined Pipe." Bulletin T-100. Haveg Industries, Inc. 2 pages. The sizes, lengths, and chemical, thermal, non-adhesive, and mechanical properties of the pipe are given, together with information on dimensions and sizes.

Readers' Service Item L-38

"Vinyl Foam News Letter." Elastomer Chemical Corp. 4 pages. New uses for the company's Vinylfoam, flexible, open-cell vinyl foam, are described briefly on the first page of this folder. The properties, advantages, processing, and applications of the material are tabulated on the other three pages.

Readers' Service Item L-39

"Plasticizers, 1957." Hatco Chemical Co. 8 pages. Complete specifications, uses, and physical properties are given for the firm's sebacate, furmarate, adipate, and phthalate plasticizers. New products are described for use in the textile, detergent, rubber, paper, and leather industries.

Readers' Service Item L-40

Book Reviews

"The Effects of Fungus Growth and Moisture upon the Strength Properties of Reinforced Plastics." R. C. Tomashot and E. L. Hamilton, Wright Air Development Center. Order PB 121513 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 13 pages. Price, 50¢.

Glass fabric-reinforced laminates supported less fungus growth than paper- and cotton-reinforced specimens. Variations in resin chemical type seemed to have no effect on the fungus susceptibility of glass fiber laminates. Improved, water-resistant finishes on glass fabric appeared to retard growth, and strength reduction was about the same for laminates exposed to moisture alone as for those exposed to moisture plus fungus growth.

"Development of Low-Temperature Fungus-Resistant Vinyl Compounds." W. W. Jackson, Jr., Wright Air Development Center. Order PB 111929 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 18 pages. Price, 50¢.

A PVC tubing compound with low-temperature, fungus-resistant, and dielectric properties exceeding those required by Air Force specifications was developed. The material consists of a PVC/polyvinylidene chloride copolymer in combination with an epoxy-fatty acid ester as a plasticizer-stabilizer, plus 1-fluoro 3-bromo 4,6-dinitrobenzene as a fungicide. Complete resistance to fungi was reported, along with a high degree of transparency and very slight tinting.

"Defects of Importance in the Specification of Reinforced Plastic Products." F. R. Barnet, Naval Ordnance Laboratory. Order PB 121277 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 53 pages. Price, $1.50.

Intended as a guide to the selection of quality plastic laminates, this report points out the common defects which appear in polyester resins and polyester-glass cloth-glass mat laminates. It supplements military specifications, and provides exacting standards for procurement of quality materials.

Primary flaws such as air and gas bubbles, crazing, patches, and delaminations are illustrated and discussed in terms of their effects in use. An appendix lists allowable flaws under typical service conditions.

"The Chemistry of High Polymer Degradation Processes." Norman Grassie. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth 5¾ by 8¾ inches, 350 pages. Price, $6.50.

An understanding of polymer degradation reactions is necessary in order to predict the behavior and deterioration of commercial plastic materials. These same reactions have produced a vast range of new substances, whose molecular structures cause them to undergo still different series of reactions.

The stated purpose of this book is to outline our present state of knowledge concerning polymer degradation reactions, to explain the constituent reactions which make up the composite weathering and deterioration processes, and to explain the kinetics of chemical change.

A chapter is devoted to depolymerization of polymethyl methacrylate, polystyrene, polyethylene, and other polymers, plus a discussion of depolymerization as a chain- or mechanically-induced, and as a reversible reaction. Other chapters are concerned with hydrolysis, oxidation, sulfuration, ozonization, and non-chain scission reactions. Numerous tables, graphs, and formulas are included.

"Induction Heating Practice." D. Warburton-Brown. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. Cloth, 6 by 9 inches, 192 pages. Price, $10.00.

This work is intended to serve as a practical handbook of the application of high-frequency induction heating to the processes of brazing, soldering, hardening, annealing, tempering, and other heating requirements. Although the process has been used industrially for a relatively short time, high-frequency induction heating has been adopted widely wherever controlled heats are required.

Chapters are devoted to the design of work-coils and inductors, jigs, and handling mechanisms, and the modification of existing components and assemblies to facilitate such adoption. Applications, both general and specific, are given along with full production data. Illustrations, diagrams, and tables are included.

"Engineering Inspection Measurement and Testing." H. C. Town and R. Colebourne. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. Cloth, 6 by 9 inches, 192 pages. Price, $8.75.

Intended to serve both the student of metrology and the engineer engaged in precise measurement and inspection, this work begins by explaining the function of the factory inspection department. This includes line inspection, accuracy of tools, and distribution of chance variations. The development of recognized standards and methods of measurement is traced from its origin up to the present.

Later chapters deal with the principles and practice of precise measurement, including such comparators as the sigma-mechanical, the electric, the optical lever, the pneumatic gage, and the matrix measurer. Measurement during machining automatic sizing) is discussed along with workshop inspection methods and calculations. The final chapters are devoted to screw-thread measurement, and to determining the dimensional accuracy of surface finishes. Numerous photographs and diagrams are included.

"Commercial Waxes." Second Edition. Edited by H. Bennett. Chemical Publishing Co., Inc., 212 Fifth Ave., New York 10, N. Y. Cloth, 5½ by 8¾ inches, 688 pages. Price, $15.00

The first two chapters are devoted to an explanation of the natural waxes, which include mineral, vegetable, animal, and insect waxes; and the synthetic waxes, which are derived from fatty alchols, fatty acids, polyglycols, polyhydric alchol-fatty acid esters, hydrogenated oils, chlorinated naphthalenes, acrawaxes, alcowaxes, santowaxes, and other miscellaneous manufactured waxes.

These chapters are followed by a description of the physical properties of waxes and wax compositions; methods of testing for purity, identification, determining melting points and solvents, making emulsions, and coloring; and a description of waxes in industry. The latter includes paper finishes, polyethylene-wax packaging, and protective coatings.

"Polymer Solutions." H. Tompa. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. Cloth, 5½ by 8¾ inches, 339 pages. Price, $8.50.

This book concerns itself with those properties of polymer solutions from which information can be derived as to the structure, size, and shape of the polymer molecule. These include both thermodynamic properties. Sedimentation and birefringence are omitted, since they require highly specialized techniques for their determination. Light-scattering, however, is taken into consideration.

Topics are treated in the following order: thermodynamics and statistical mechanics, including potentials, functions, mole fractions, coexisting phases, condensed systems, conditions of stability for binary and ternary systems, and the partition function; theories of liquids and solutions; theories of polymer solutions; vapor pressures and heats of mixing; osmotic pressure; phase relationships; chain configurations; viscosity; and light-scattering. Numerous graphs and formulas are included, along with a list explaining the principal symbols used throughout the book.

Abstracts of Important Articles

Materials

"The Plasticization of PVC," O. Leuchs, *Kunststoffe,* 46, 12, 547 (Dec. 1956).

Plasticizer action consists essentially of lowering the second-order transition temperature in PVC and this, in turn, depends on intermolecular forces. The quantitative relations of polar and non-polar groups present in a plasticizer determine its compatibility with PVC. Plasticizers come in two major types: (1) polar-aliphatic, such as trioctylphosphate, which are difficult to incorporate, but greatly increase cold resistance; and (2) polar-aromatic, such as tricresylphosphate, which have less effect on cold resistance, but are easily incorporated. The first type screens off the polar groups of the PVC molecule, and are termed by the author as "screen" or "barrier" plasticizers; the second transmits intermolecular forces by a kind of hinge action, and are called "hinge" or "transmitting" plasticizers. The plasticizers commonly used are chiefly intermediate types between these extremes. These studies led to new suggestions for improving cold resistance and internal plasticization of polymers: The latter could be achieved by introducing alkylene chloride in vinyl chloride during polymerization, and phenyl propylene, phenyl butylene, or the like in polystyrene. (In German).

"Polyvinylchloride Agglomerates," G. Wick and H. Konig, *Kunststoffe,* 46, 12, 583 (Dec. 1956).

Agglomerates 0.5-5 mm. in diameter, that are slightly gelled, dry and free-running, and can be fed directly to extruders without preliminary gelling and granulating, are economically prepared from plasticized PVC in suitable mixers, if pressure, temperature, and time are controlled carefully. High-speed mixers which have efficient cooling and heating systems and produce frictional and centrifugal forces in the mix have proved satisfactory. The preparation of agglomerates from PVC emulsion (containing up to 45% plasticizer) and plasticized PVC suspensions is described. Processing of both types of agglomerate is compared with that of granulated PVC when the ratio of plasticizer to resin is 30:70 for all types. (In German).

"High Molecular Weight Nylon," W. Stiner, *Plastics,* 21, 225, 141; 21, 226, 174; and 21, 227, 207 (June, July, August 1956).

The new high molecular-weight caprolactam nylons known as Grilon F 35 and Grilon F 50, are compared with other polyamide types. The first of these Grilons has molecular weight approximately double that of the usual polyamide plastics, while the molecular weight of the second is still higher. These materials can be used for making blown foil and flat sheets, using slit dies. Grilon R 50 is suitable for bottle-blowing by the extrusion process, manufacture of pipes and tubings, and special injection moldings requiring maximum resistance to impact fatigue. The processing techniques are described. Finally, the properties of Grilon as packaging material, especially for foodstuffs, are dealt with, also the procedure for making bags from blown tubes or extruded foil.

"Examination of Macromolecular Substances by Osmotic Measurements," H. Hellfritz and H. Kramer, *Kunststoffe,* 46, 10, 454 (Oct. 1956).

In practice, not all sources of error that might adversely influence osmotic measurements are always taken into account. Hence, the authors undertake to discuss all the factors relating both to the osmometer and the membrane. The chief technical requirements of osmometers are dealt with, and the main structural features and resultant characteristics of the most widely used types are described and tabulated. The selection and treatment of membranes and methods of testing them are considered. Finally, a number of essential and useful general joints are reviewed. (In German).

"Contribution to the Formation of Resin from Urea and Formaldehyde," J. F. Ehlers, *Kunststoff-Rundschau,* 3, 6, 193 (June 1956).

The similarity of phenol and urea resins has been ascribed to the fact that both resins contain methylene and also methylene-ether bridges. Studies showed that in the case of phenols, methylene bonding is effected in acid; and in that of urea, in alkaline medium. Alkaline and acid reactions, respectively, are responsible for the other bridges in phenol and urea. In both resins, the methylene bridge is directly due to the reaction of a p-type methylol, while the methylene ether bridge is due to the reaction of a p-type with an o-type methylol. The difference in the methylol groups is caused by the position of the methylol group with reference to the hydroxyl of the nucleus (in the case of phenol), and to the alternation of the asymmetric with the symmetrical form of the urea molecules (in the case of urea). (In German).

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Requests for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in June.

"Plasticizers for PVC. I. Types in Current Use," I. Phillips and P. Youde; "II. Future Developments," E. Chadwick, *Brit. Plastics,* 29, 9, 337 (Sept. 1956).

In part I, a statement of the basic requirements of a plasticizer for PVC is followed by a summary of plasticizers grouped under their chemical classes, and details of test methods for evaluating general-purpose PVC compounded with various plasticizers. In Part II, dealing with future developments, materials now appearing in the United States are examined, since information gained there can stimulate new lines of approach more suited to British procedure. Mention also is made of the recent development of chlorinated alkyl benzenes in Germany and similar products in France, as well as to the renewed interest in dimethyl thianthrene which has long been available in Germany.

"Changes in the Weight and Length of Test Pieces of Amino Plastics," E. Gwinner, *Kunststoffe,* 46, 10, 467 (Oct. 1956).

Changes in weight and dimensions were studied with phenolic urea, and melamine resins with various fillers when subjected to extreme conditions (dry heat from 30-180° C., and storing in water), and for two years to the conditions in a testing laboratory used daily and heated in winter. All samples stored under the latter conditions underwent irregular but similar variations in weight and dimensions, the absolute values of which very largely depended on the composition and the preheating of the materials. All measurements were made on simple, standard test bars respectively; the values obtained cannot be applied to moldings having other dimensions. (In German).

"Combustibility and Inflammability of Foils," H. Mendryzyk, *Kunststoffe,* 46, 10, 489 (Oct. 1956).

After reviewing present specifications on testing for combustibility and inflammability of foils in France, Britain, the United States, and Germany, the author describes a new instrument developed on the basis of the Willbourn method, but also influenced by the Pickhard and Hird system. This device is claimed to be easier to assemble and clean, and to be well suited to evaluating the inflammability of plastic foils freely suspended and exposed to a

flame of medium intensity. This method is chiefly designed to determine whether foils are ignited by a small source from which the fire spreads to neighboring combustible articles. (In German).

"Identification of Plastics, Resins and their Products by Infra-Red Spectroscopy," D. Hummel, *Kunststoffe*, 46, 10, 442 (Oct. 1956).

After discussing the theoretical and practical limitations of infra-red spectroscopy, the author describes a plan for systematizing the analysis of plastics and lacquers which makes the fullest use of the possibilities of the method. Spectra of these materials, as well as of their most important ingredients and decomposition products, are collected and arranged with the aid of IBM cards and index cards with perforated borders. A table shows the classification, under 10 main heads, of the materials examined. Examples are given of auxiliary physical and chemical methods developed to provide added information to insure greater accuracy in judging materials with less characteristic spectra, also of methods for analyzing mixtures. (In German).

"Investigation of Flow Properties of Plastic Molding Compounds," C.M.v. Meysenbug, *Kunststoffe*, 47, 1, 14 (Jan. 1957).

To demonstrate the differences in the flow behaviors of various types of plastics and, at the same time, the versatility of a new flow-testing device (previously described), a series of tests was carried out on thermosetting molding materials (in powder and chip forms) and on thermoplastics, and some characteristic curves analyzed. (In German).

Equipment

"Production of Sheet from Toughened Polystyrene," D. G. Peacock, *Brit. Plastics*, 29, 10, 369 (Oct. 1956).

Toughened polystyrene sheet is extruded from a center-fed slit die, and passed between heated rollers which gage the sheet and cool it until it is self-supporting. At the same time, the sheet is polished. Next, the sheet passes through a pair of rubber tension rolls which keep it flat in the final cooling stage. The sheet is cut to correct width by two pairs of trim wheels, and then to desired length with a high-speed guillotine cutter actuated by a photo-electric cell. The design of the extruder and die, as well as the finishing and handling of the sheet, are described in detail.

"Determining the Pot-Life, Hardening Time and Gelling Period of Unsaturated Polyester Resins," H. Schirmer, *Kunststoffe*, 46, 12, 588 (Dec. 1956).

In judging unsaturated polyester resins,

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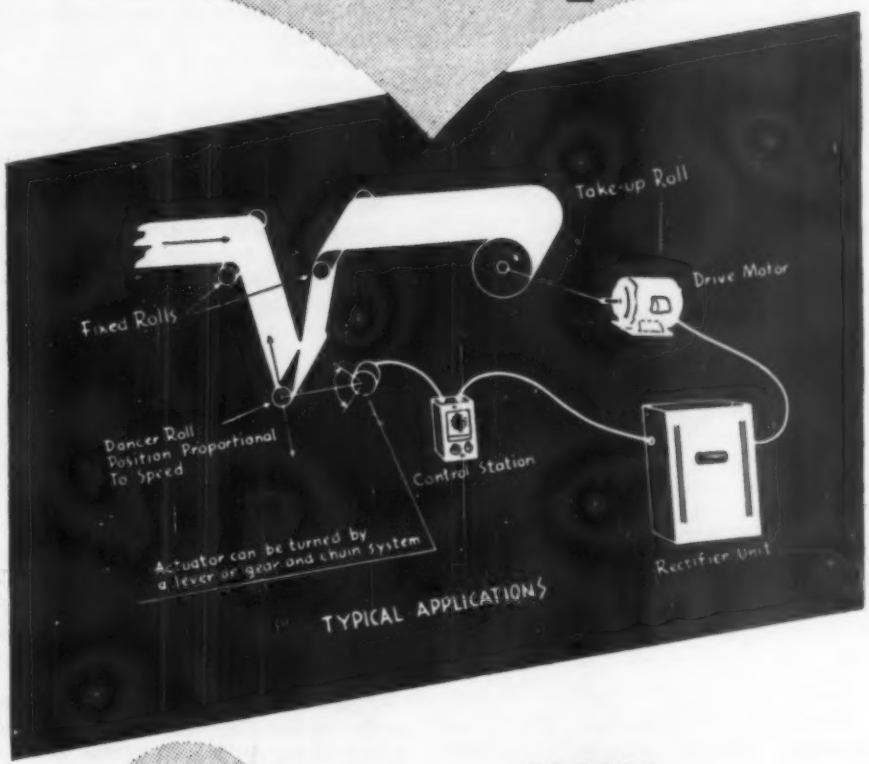
Take-Up



Here's HOW IT WORKS ...for Textile and Plastics Processing

A small tension change positions the actuator shaft so as to call for motor speed change to restore preset tension. Thus a constant linear feet per minute windup may be achieved even though the radius of takeup roll increases with each turn to otherwise increase linear speed versus radius build-up. Speed is now made proportional to position of dancer roll and tension is held essentially constant, as is the linear rate of material travel.

These and other models of electronic motor speed control systems available from 1/50th to 2 horsepower.

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Servospeed
DIV. of ELECTRO DEVICES, Inc.
4 Godwin Ave. Paterson, N. J.

the most important factors are pot-life, hardening time, and gel time. Of the various testing methods hitherto employed, none has permitted determination of both temperature and viscosity on the same sample. This is possible now with a tongue viscometer designed and built in collaboration with the Physical Laboratories of Farbenfabriken Bayer A.G. The device includes a steel tongue made to oscillate by means of an electro-magnet. It has two recorders; one traces the changes in viscosity, while the other registers the changes in temperature, so that the recording tape shows both the viscosity/time and temperature/time curves. (In German).

Processing

"Printed Electric Circuits," G. Schipani, *Mat. Plastiche,* 22, 9, 728 (Sept. 1956).

Of the five principal methods by which printed circuits can be made, four are briefly described: (1) sprayed circuits; (2) General Electric's Thru-Con method; (3) silver circuits on ceramics; and (4) mechanically stamped circuits. The fifth method (chemical removal of excess metal from a continuous copper layer, now generally used in the United States and slowly being introduced in Italy) is discussed in detail, and circuits for various purposes are considered. (In Italian).

"Method of Producing Blocks of Styropor," K. H. Krause, *Kunststoff-Rundschau,* 3, 9, 334 (Sept. 1956).

Large blocks of Styropor (expanded polystyrene) can be produced in autoclaves by introducing steam throughout the prefoamed plastic. This is achieved by bore holes in the surfaces of the mold, and channels formed in the interior of the prefoamed mass in the mold by blowing a short blast of steam through thin-walled pipes inserted into the mass and later removed. The channels thus produced disappear as the material expands during the usual treatment in the autoclave and large, uniform blocks are obtained if proper preparations are taken. (In German).

"Production of Plastic-Coated Packaging Papers," G. Hagen, *Kunststoff,* 47, 1, 2 (Jan. 1957).

The principal method of improving packaging papers by coating with plastic include lamination-coating with polyethylene, application of aqueous solutions of copolymers of vinylidene chloride and vinyl chloride by means of special air-brush installations, and spreading of polyamide/alcohol solutions. Mixtures of plastics and paraffins also are used. The author discusses the properties, advantages, and disadvantages of the materials and methods. In connection with paraffin-plastic mixtures, he suggests that when the proper processing equipment has been developed, combinations of inexpensive paraffins with more than 15% ethylene and isobutylene polymerizates may prove of special interest. (In German).

"The Manufacture of Laminated Plastics by Automatic Control," W. H. Goldstein, *Plastics,* 21, 228, 221 (Sept. 1956).

Automatic control of the various manufacturing stages in the production of laminated plastics is discussed under the headings of resin production, impregnation, and pressing.

"Automation and the Plastics Industry," J. A. Sargrove, *Plastics,* 21, 228, 225 (Sept. 1956).

The author explains the application of automation in the plastics industry by two examples: the Sargrove E.C.M.E. process for making circuit panels; and automatic control of the extrusion of plastics rods.

"Automation in Injection Molding," L. Griffiths, *Plastics,* 21, 228, 232 (Sept. 1956).

Brief review of present trends and limitations of automation in the injection molding industry.

Applications

"An Approach to the Design of Glass Reinforced Structures," P. H. H. Bishop, *Brit. Plastics,* 29, 11, 415 (Nov. 1956).

Some aspects of the design of glass-fiber structures are discussed, with special reference to the application of the technique of miniaturization to structures of glass-fiber laminates.

"Hostaphan—Film from Polyterephthalic Acid Ester," O. Herrmann, *Kunststoffe,* 46, 12, 582 (Dec. 1956).

The properties and applications of Hostaphan polyester film produced by Kalle & Co., A. G., are reviewed. (In German).

"Glass Fiber-Reinforced Plastics as Building Materials," W. Beyer, *Kunststoffe,* 46, 12, 590 (Dec. 1956).

The author discusses the properties of glass fiber-reinforced plastics suitable for use in the building industry, and methods of preparing the sheets. A further article will deal with the employment of these materials for load transmission. (In German).

"Advances in the Finishing of Wood Surfaces with Unsaturated Polyesters," K. H. Hauck, *Kunststoff-Rundschau,* 3, 7, 244 (July 1956).

The author describes the difficulties of poor adhesion, sensitivity to air during drying, coating of vertical surfaces in a single operation, and short pot life which hamper the use of unsaturated polyesters in finishes for wood and other surfaces, and how these have been overcome. The problem of short pot life is solved by a new process by which the peroxide catalyst for the polyester-styrene mix is incorporated in the binder instead of in the resin material. The binder plus peroxide serves as an undercoat for the surface to be treated and, when dry, forms a film on which the polyester-styrene mix, sprayed on subsequently, will harden without the need for additional catalyst. (In German).

"Plastics for Electrical Commutators," A. S. Arnatt, *Canad. Plastics,* 42 (July 1956).

Two types of Bakelite phenolics are used in making electrical commutators; TM 250 Brown, to insulate segments, and BM-1957 Natural, for holding the segments in a ring. The properties of the plastics, method of assembling the fixtures, molding equipment, and molding operations are described.

"Plastics in the Foundry," H. Burton, *Canad. Plastics,* 26 (July 1956).

The Canadian Car and Foundry Co., Ltd., was able to cut costs of patterns by using plastic patterns and core boxes reinforced with epoxy resins. The types, machinery, and methods are discussed, and costs compared with those for similar metal equipment.

General

"The Changing Meaning of the Concept 'Polyester'," G. Tewes, *Kunststoffe-Rundschau,* 3, 7, 241 (July 1956).

The literature reveals considerable confusion over the concept "polyester," as the author shows by a partial listing of the compounds included under saturated and unsaturated polyesters. He proposes that only such plastics be designated "Polyesters" whose macromolecular chains, nets, etc., are built up by esterification. (In German).

"Productivity Comparisons in the Plastics Industry," C. Prael, *Kunststoffe,* 46, 12, 564 (Dec. 1956).

How comparisons of costing and productivity of different firms can aid the individual company to assess its own efficiency is explained and illustrated by an example. (In German).

"The Economic Stabilization of Vinyl Chloride Polymers," H. V. Smith, *Brit. Plastics,* 29, 10, 373 (Oct. 1956).

The available types of stabilizers are described, and the factors considered which determine choice of stabilizers. These factors include cost and suitability for the compound, the process, and the service conditions.

Patent Digest

Materials

Process for Polymerizing Chlorotrifluoroethylene. No. 2,766,215. William N. Stoops and Bruce Thompson, Charleston, W. Va. (to Union Carbide & Carbon Corp., New York, N. Y.).

Monomeric chlorotrifluoroethylene is dispersed in an aqueous solution containing a water-soluble polymerization catalyst and a perhaloalkanoic acid as a dispersing agent. The monomer is then polymerized.

Condensation Products of Urea-Formaldehyde Resin and an Amide and Methods for Producing Them. No. 2,765,287. Benjamin F. Aycock, Elkins Park, Pa. (to Rohm & Haas Co., Philadelphia, Pa.).

A high-molecular-weight, hydrophobic amide is reacted with a condensation product of urea and at least two moles of formaldehyde for each mole of urea and at least 2.5 moles of methanol or ethanol.

Solutions of Acrylonitrile Polymers in Mixtures of Ethylene Carbonate and 1:2-Propylene Carbonate. No. 2,764,469. Ernest Jan Kowolik and James Wotherspoon Fisher, London, England (to British Celanese, Ltd., England).

The solutions comprise an acrylonitrile polymer having an acrylonitrile content at least 85% by weight, dissolved in a solvent mixture of ethylene carbonate and 1:2-propylene carbonate. They can be cooled to temperatures below 35° C., before solidifying.

Polyesters Reacted with Tolylene Diisocyanate. No. 2,760,953. Nelson V. Seeger, Silver Lake, O. (to Goodyear Tire & Rubber Co., Akron, O.).

A polyester is prepared from bifunctional ingredients including at least one dibasic carboxylic acid and at least one glycol. It is then reacted with at least one bifunctional amine additive and at least one tolylene diisocyanate.

Preparation of Water-Soluble Sulfonated Styrene Polymers. No. 2,764,576. Bruno Blaser, Dusseldorf-Urdenbach, Malte Rugenstein, Dusseldorf-Holthausen, and Guenther Tischbirek, Dusseldorf-Benrath, Germany (to Henkel & Cie., Dusseldorf-Holthausen, Germany).

A styrene polymer dissolved in an aliphatic, halogenated hydrocarbon is contacted with a sulfur trioxide-ketone. The sulfonated styrene polymer is recovered on cooling.

Vinyl Chloride Polymers Plasticized with a Mixture of Glycol Dibenzoates. No. 2,764,571. Robert S. Montgomery, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

The plasticizer consists essentially of 10-70% by weight diethylene glycol dibenzoate and 30-90% by weight of dipropylene glycol dibenzoate.

Process for Making Destaticized Plastic. No. 2,758,984. Myron A. Coler, New York, N. Y.

The molding composition consists of comminuted particles of a thermoplastic resin no finer than 100 mesh and about 3-60% by volume of a finely-divided urea- or phenol aldehyde resin; the latter being no coarser than 200 mesh. The thermosetting material retains water in absorbed form when heated to the molding temperature of the thermoplastic material, and releases it irreversibly on curing.

Polymerization of Vinyl Chloride with Ethyl Bromomalonate Modifier. No. 2,764,579. Dexter C. Seymour, Wyckoff, N. J. (to United States Rubber Co., New York, N. Y.).

Vinyl chloride is polymerized at 25-60° C., in the presence of a free radical-producing polymerization initiator and 0.1-8% ethyl bromomalonate.

Vinyl Sulfonamide-Acrylonitrile Copolymers. No. 2,760,955. Harold F. Park, East Longmeadow, and Robert M. Dickey, Wilbraham, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

The copolymer contains 85-99 parts of acrylonitrile and 1-15 parts vinyl sulfonamide.

Plasticized Sheet of Cellulose Triacetate. No. 2,759,836. John R. Caldwell, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

The plasticizer is a dialkyl ester of 1,4-endomethylene hexahydro-2,3-phthalic acid in which each alkyl group contains 1-4 carbon atoms. The finished sheet is transparent and flexible.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

Aromatic Vinyl Compound-Acenaphthene Compound Copolymer and Process of Producing the Same. No. 2,768,147. Helmut Meis and Hubert Sauer, Letmathe, Germany (to Rutgerswerke-Aktiengesellschaft, Frankfurt am Main, Germany).

An aromatic vinyl compound is copolymerized with an acenaphthene compound, the latter being present in the range of 10-100% by weight.

Solution Polymerization of Acrylonitrile. No. 2,768,148. Calvin E. Schildknecht, Montclair, and Mary L. Wallace, Summit, N. J. (to Celanese Corp. of America New York, N. Y.).

Polymerization is carried out in the presence of a solvent selected from the class consisting of aliphatic cyclic carbonates and lactones containing 3-6 carbon atoms in the ring, and which will not enter into the polymerization reaction.

Process for the Production of Melamine. No. 2,768,168. Joseph Newton Robinson and Frederick John Leslie Miller, Trail, British Columbia, and Basil McDonnell, Rossland, British Columbia, Canada. (to Consolidated Mining & Smelting Co. of Canada, Ltd., Montreal, P. Q., Canada).

Urea, sulfur dioxide, and ammonia are heated in a closed vessel, under superatmospheric pressure, to a temperature of 300° C. The reaction is continued for about two hours.

Process for Polymerizing Vinyl Chloride. No. 2,772,256. Michael A. Manganelli, Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

The process involves polymerizing 100 parts of vinyl chloride in aqueous suspension with an oil-soluble catalyst and a suspending agent of vinyl acetate and maleic anhydride-ethylene oxide. The polymer produced is both granular and porous.

Polyamide Resin Suspensoids with Reversed Charges. No. 2,768,090. Harold Wittcoff and Malcolm M. Renfrew, Minneapolis, Minn. (to General Mills, Inc., Minneapolis, Minn.).

A polyamide is dispersed cationically in an aqueous medium by adding sufficient acid to react with the free amine groups to form intrinsic salt groups. An anionic emulsifier is added to convert the suspensoid to an anionic one.

Water-Soluble Epoxy-Amine Resins. No. 2,772,248. Emanuel R. Lieberman, Woodside, and Henry Yuska, Kew Gardens, N. Y. (to Interchemical Corp., New York, N. Y.).

The amine resin is the reaction product of an aliphatic polyamine and a resinous epoxide with an epoxide equivalent of 225-1,000. The amine should have at least two nitrogen atoms and contain no aliphatic chain longer than four carbon atoms.

Acrylonitrile Polymers Stabilized with Salts of Vinyl Sulfonic Acid. No. 2,772,-250. Robert J. Slocombe, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

An acrylonitrile polymer containing an intimate dispersion of 0.01-10% of a salt of vinyl sulfonic acid is copolymerized with a monoolefinic monomer.

Copolymers of Vinyl Chloride and 1,1-Dichloro-Ethene. No. 2,769,803. Wilhelm Becker, Leverkusen-Bayerwerk, Germany. (to Farbenfabriken Bayer Aktiengesellschaft, Leverkusen, Germany).

At least 15% vinyl chloride, 15% 1,1-dichloroethene, and 1-25% styrene are emulsified and copolymerized in an aqueous medium, and in the presence of about 0.5% of a regulating agent and a solvent for the film-forming agent.

Solutions of Copolymers of a Perfluorochloroethylene and a Fluoroethylene. No. 2,770,605. Francis J. Honn, Westfield, N. J. (to M. W. Kellogg, Jersey City, N. J.).

The copolymer containing 69-80% of a perfluorochloroethylene copolymerized with a partially-fluorinated ethylene. An ester, ketone, or ether alcohol, having a boiling point between 55-160° C., is used as a solvent.

Thermosetting Resin. No. 2,772,254. Anthony H. Gleason, Westfield, and Joseph F. Nelson, Rahway, N. J., (to Esso Research & Engineering Co.).

A sodium copolymer of 50-100% butadiene 1,3 and 0.50% styrene is heated to 110-175° C., in the presence of ditertiary butyl peroxide until a solid resin is obtained.

Purification of Acrylonitrile. No. 2,770,-645. David W. McDonald, Texas City, and Keith M. Taylor, La Marque, Tex. (to Monsanto Chemical Co., St. Louis, Mo.).

Acrylonitrile containing methyl vinyl ketone is treated with a minor amount of alkali metal, alkaline earth metal, and ammonium bisulfites.

Equipment

Plastic Measuring Device. No. 2,758,338. Donald C. Lynn, Los Angeles, Calif. (to Crown Cork & Seal Co., Inc., Baltimore, Md.).

The device, intended for measuring a fixed charge of plasticizer, comprises the following parts: hopper, material cylinder, plasticizing cylinder, measuring cylinder and chamber, and a time-operated valve.

Apparatus for Continuous Polymerization. No. 2,758,915. Joseph Leonard Vodonik, Rocky River, O. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

A pair of horizontal, parallel, oppositely-driven shafts; a series of spaced, solid, flat discs fixedly mounted on each shaft and intermeshing with each other; a casing for housing the discs in compartmental fashion; a polymer inlet at one end of the casing; a vapor outlet; a vacuum means; and a heating means make up this polymerization apparatus.

Apparatus for Applying Plastic Coating to Wire. No. 2,760,229. Marvin C. Cheney, Hamden, and Clarence I. McCall, Waterbury, Conn. (to Lewis Engineering Co., Naugatuck, Conn.).

Cohesive insulation particles are formed and compacted under pressure into a substantially-solid wire covering. The unit comprises a number of narrow rollers with annular grooves in their peripheries, and which coengage on both sides of the grooves; a means for turning the rollers; and a means for providing an enclosure through which the wire and insulation passes.

Extruder Head. No. 2,758,337. Ray C. Kivley, Kenmore, N. Y. (to Western Electric Co., Inc., New York, N. Y.).

This extrusion head for a cable-sheathing machine comprises a housing mounted on the exit end of a cylinder for material to be extruded about cores of different sizes; a die block which opens to the cylinder and has an aperture extending longitudinally through the cylinder; a core-tube holder grooved to receive the material from the cylinder; a die with an opening; a clamp for holding the die in the exit portion of the die block; and a core tube for a cable core of predetermined size.

Plasticizer for Injection Molding Machines. No. 2,764,781. George W. Kelly, Columbus, O. (to Columbus Plastic Products, Inc., Columbus, O.).

This thermal plasticizer comprises a casing with an internal, axially-disposed chamber. An inlet receives the unplasticized material, and a relatively-restricted outlet discharges them. Other parts include a heating means, a rotary core, a number of anti-friction devices, a number of restricted passages, and a means for causing axial rotation of the core.

Multiple Screw Extruding Press. No. 2,764,780. Hans Reifenhauser, Troisdorf, Germany (to Hugo Stinnes Verwaltung, Mulheim an de Ruhr, Germany).

The press comprises an outer, elongated tubular casing; an elongated, hollow worm screw with both outer and inner screw threads; an elongated stationary guide, which is hollow and forms a second casing; and a second worm screw located within the second casing.

Plastic Material Extrusion Head. No. 2,760,230. Jurian W. VanRiper, Ridgewood, N. J.

The mechanism has a chamber for conducting plastic material and a means for forcing this material through a right-angle passage. These forwarding means are mirror images of each other, and are of right helicoidal shape.

Processing

Process of Removing Wax, Plastic, and Like Pattern Materials from Thin Shell Molds. No. 2,759,232. Geza Demeter, Cranford, N. J., and James C. Johnson and Francis X. Maher, Jr., New York, N. Y. (to Arwood Precision Castings Corp., Brooklyn, N. Y.).

The mold containing the pattern is immersed in a liquid which is heated to a point between the boiling point of the liquid and the melting point of the pattern material. Heating is continued only long enough to melt pattern material adjacent to the interior mold surface. Expansion of the unmelted remainder permits easy removal.

Method of Forming Combined Metal and Plastic Article. No. 2,765,248. Thomas C. Beech and Richard T. Beech, Roseville, Mich.

A die is formed with an open cavity using an easily-worked, porous material. The pores are sealed within the die

cavity, and molten metal is sprayed against the cavity walls under high pressure to form a thin, high-density surface. The spray is then continued under low pressure to form a less-dense, porous backing. While the metal is still hot, a thermoplastic backing layer is applied within the shell. The articles are ready for removal from the die as soon as the plastic and metal are bonded.

Method of Making Transparent Laminates. No. 2,760,893. Francis F. Koblitz and Jack G. Hilden, Madison, Wis. (to Bjorksten Research Laboratories, Inc., Madison, Wis.).

Diethyl polysiloxane resin is compressed to a thickness less than ⅛-inch between glass plates, and heated to 105-125° C. for 30-60 minutes. The laminate is then subjected to a pressure of 7,000-10,000 psi., and reheated to 65-95° C. for 1-10 minutes.

Method of Making Curved Sheets from Polymerizable. No. 2,760,233. Johan Bjorksten, Madison, Wis.

A layer of incompletely-polymerized material is floated on the surface of a liquid having a higher specific gravity, polymerized, and applied to a layer of material of greater magnitude under fluid pressure.

Method of Treating Resinous Materials to Improve Their Adhesion Characteristics. No. 2,764,502. Cherry L. Emerson, Jr., Duxbury, Mass. (to Emerson & Cuming, Inc., Canton, Mass.).

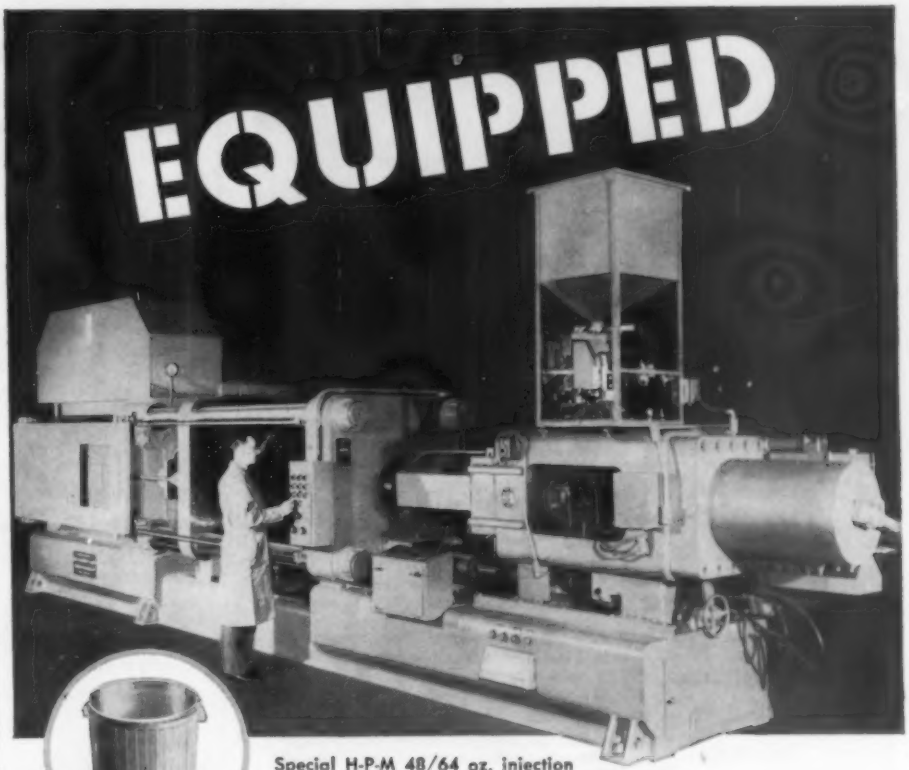
Polyamides and polyesters are prepared for cementing by contacting their surfaces with an aqueous, alkaline solution; rinsing to remove said solution; contacting with an aqueous salt of tin or lead; rinsing same; and drying.

Method and Apparatus for Treatment of Polyethylene. No. 2,767,103. Serge A. Loukonsky, Hartford, Conn. (to Plax Corp., West Hartford, Conn.).

Polyethylene film is drawn over a liquid-cooled supporting member to produce a partial vacuum on the film's surface, and a flame is directed onto the film at the point of disengagement. This renders the film surface more receptive to adhesives and inks.

Process for Impregnating Fibrous Material Derived from Tetrafluoroethylene Polymer and Product. No. 2,764,506. John Augustus Piccard, Swarthmore, Pa. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

Fibrous material derived from a tetrafluoroethylene polymer is impregnated with a dispersion of tetrafluoroethylene to form a coagulum.



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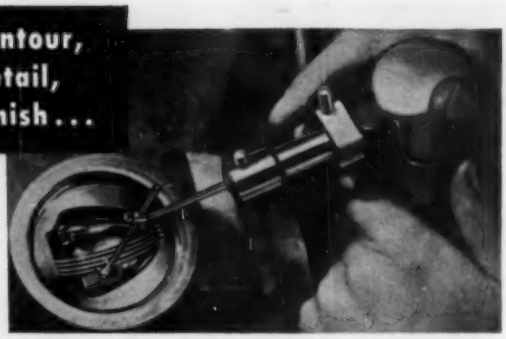

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CALENDAR of COMING EVENTS

April 23
SPE Philadelphia Section. Franklin Institute, Philadelphia, Pa.
SPE Central Indiana Section. Warren Hotel, Indianapolis, Ind.

April 24
Reinforced Plastics Group, SPE New York Section. Tufaro's Restaurant, Corona, N. Y.

SPE Quebec Section. Queen's Hotel, Montreal, P. Q.

May 1
SPE Western New England Section. Bradley Field, Windsor Locks, Conn.

May 2
SPE Southern California Section. Scully's Restaurant, Los Angeles, Calif.

May 8
SPE Newark Section. Military Park Hotel, Newark, N. J.

May 10
SPE Cleveland-Akron Section. Spanish Tavern, Brecksville, O.

May 14
SPE Baltimore-Washington Section. Langley Park Hot Shoppe, Takoma Park, Md.

May 15
SPE New York Section. Governor Clinton Hotel, New York, N. Y.

May 20-22
ASME Design Engineering Conference. New York Coliseum, New York, N. Y.

May 22-24
American Institute of Chemists. "The Chemist & Management Appraise Each Other." Thirty-fourth Annual Meeting. Sheraton-Mayflower Hotel, Akron, O.

June 16-21
ASTM Annual Meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 10-20
British International Plastics Exhibition. Grand & National Halls, Olympia, London, England.

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Industrial News Briefs (Cont'd from p 309)

Plastic Process Co., Division of Monadnock Mills, has moved to new and larger quarters at 11200 Hindry Ave., Los Angeles, Calif.

Goodyear Tire & Rubber Corp.'s chemical division has set up new quarters for two of its field offices. The Boston office is now located at 66 B St., Needham Heights 94, Mass., and the Cleveland office is at 7007 Brook Park Rd., Cleveland 29, O.

Archer-Daniels-Midland Co., Minneapolis, Minn., has announced the approval by the Food & Drug Administration of its Admex 710. The material can now be used as a plasticizer in vinyl film and tubing used to wrap or convey food.

Sprits has announced a change in corporate address to 146 Merrick Rd., Lynbrook, N. Y. The move provides considerable more production space.

Domestic Production and Sales of Plastics and Resin Material, November and December, 1956

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of November and December 1956. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Over-all sales showed a sharp decline during the month of December, as might be expected at this time of year. The exceptions were, as usual, the three newer materials which continue to gain favor: Vinyls, Polyethylene, and Polyesters.

	November		December	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,447,542	1,580,737	1,646,813	1,652,538
Sheets, 0.003 gage and over	1,379,002	1,426,289	1,509,653	1,549,620
All other sheets, rods, and tubes	547,831	548,194	567,333	498,715
Molding and extrusion materials	9,291,376	8,930,729	8,452,361	8,793,875
Nitrocellulose sheets, rods, and tubes	365,415	365,696	317,333	294,953
Other cellulose plastics	551,028	481,048	472,134	500,498
TOTAL	13,582,194	13,332,693	12,965,627	13,290,199
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	15,235,254	15,256,558	15,764,244	13,718,635
Bonding and adhesive resins for—				
Laminating (except plywood)	5,249,696	3,842,230	4,290,234	3,032,753
Coated and bonded abrasives	1,278,380	1,493,385	1,407,956	1,546,363
Friction materials (brake linings, clutch facings, and similar materials)[7]				
Thermal insulation (fiber glass, rock wool)	5,732,143	5,356,177	3,948,351	3,989,614
Plywood	4,777,130	3,943,221	2,985,363	2,309,966
All other bonding and adhesive uses	4,416,170	4,391,813	3,758,620	3,856,138
Protective-coating resins, unmodified and modified except by rosin	2,615,877	2,053,378	2,193,948	2,124,077
Resins for all other uses	3,456,244	2,824,139	3,051,571	2,837,738
TOTAL	42,760,894	39,160,901	37,400,287	33,415,284
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,354,669	3,223,509	2,793,724	2,896,342
Paper-treating and Paper-coating resins	2,279,064	2,423,702	2,127,900	1,976,502
Bonding and adhesive resins for—				
Plywood	9,284,105	8,371,493	7,300,791	6,959,809
All other bonding and adhesive uses, including laminating	2,214,839	2,031,876	2,195,402	2,144,398
Protective-coating resins, straight and modified	3,913,653	2,913,676	3,148,210	2,125,421
Resins for all other uses, including molding	7,135,829	8,018,471	6,951,952	6,389,398
TOTAL	28,182,159	26,982,727	24,517,979	22,491,870
Styrene Resins:				
Molding materials[1]	35,538,889	31,514,672	32,068,381	27,771,380
Protective-coating resins, straight and modified	7,087,372	6,554,887	6,877,773	4,917,611
Resins for all other uses	8,928,429	9,939,926	9,725,267	8,788,086
TOTAL	51,554,690	48,009,485	48,671,421	41,477,077
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		7,001,772		5,828,832
Sheeting (resin content)		4,773,709		3,990,255
Molding and extrusion (resin content)		19,894,771		18,278,512
Textile and paper treating and coating (resin content)[3]		5,887,745		5,415,949
Flooring (resin content)		6,252,599		5,809,643
Protective coating (resin content)		2,639,387		2,672,340
All other uses (resin content)		6,127,887		7,062,597
All other vinyl resins for—				
Adhesives (resin content)		3,114,607		2,428,729
All other uses (resin content)		10,241,738		9,296,962
TOTAL	65,900,088	65,934,215	67,870,216	60,783,819
Coumarone-Indene and Petroleum Polymer Resins	21,269,343	20,696,760	17,651,512	17,330,735
Polyester Resins	6,542,051	5,869,047	6,138,831	5,682,738
Polyethylene Resins	51,421,233	48,060,534	51,413,436	45,483,671
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1],[4]	4,154,194	4,219,990	3,882,497	3,422,974
Protective-coating resins[5]	1,335,371	578,557	1,063,098	580,102
Resins for all other uses[6]	9,823,196	9,790,955	9,796,997	9,236,459
TOTAL	15,312,761	14,589,502	14,742,592	13,239,535
GRAND TOTALS	296,525,413	282,635,864	281,371,901	253,194,928

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7]Included with "All other bonding and adhesive uses."
SOURCE: United States Tariff Commission, Chemical Division.

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Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear quarterly, while intervening issues will carry a briefer tabulation of price changes and additions.

Companies whose products do not appear are invited to submit price data for inclusion in the listing. All suppliers are requested to submit product additions and price changes promptly as they occur, in order to make this listing of maximum value to our readers.

Prices, in general, are f.o.b. works. Ranges indicate quantity or grade variations. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

—The Editor

Adhesives

Ampcoflex Adhesive	qt.	$2.75 / $3.50
Bakelite BC—17613	lb.	.54 / .84
BCU-40	lb.	.18 / .48
BR-11938	lb.	.285 / .585
Bonding resins, abrasives	lb.	.20 / .915
Brake linings	lb.	.215 / .6275
Foundry resins	lb.	.2075 / .395
Heat Insul. resins	lb.	.1425/ .37
CD Cement Nos. 200, 201, 202, 203, 204	qt.	.94 / 1.50
PS-7	qt.	2.12 / 2.90
Epon Adhesive VI, VIII	lb.	3.08 / 3.30
IX	lb.	4.25 / 4.50
Epoxy Adhesive A-1, A-3, A-4	qt.	4.45 / 6.90
A-2, A-5	qt.	5.60 / 8.00
A-6	qt.	5.80 / 8.00
C-1, C-2, C-3, C-9	qt.	5.60 / 8.00
C-4, C-7	qt.	3.69 / 5.30
Flexible Resin No. 1	qt.	4.45 / 6.90
G-E 12316	lb.	.30 / .39
12353	lb.	.225 / .385
Melmac 401	lb.	.45
421	lb.	.45 / .47
Melurac 300, 302	lb.	.25 / .29
301	lb.	.28 / .33
Metlbond 2002-14	qt.	1.84 / 5.00
4021 Type I	sq. ft.	1.43
Type II	qt.	1.29 / 3.20
Type III	qt.	1.49 / 3.50
Plaskon Phenolic Bonding Resin	lb.	.16 / .21
Urea Adhesive 530-11L	lb.	.1875/ .2175
Liquid Adhesive, 2L Types	lb.	.105 / .115
WR Types	lb.	.0675/ .125
Spray Dried Adhesives	lb.	.18 / .29
Plastic Cement	gal.	2.25 / 2.70
Pliobond 20	gal.	4.50 / 7.00
30	gal.	5.25 / 8.00
Polyester Foam Cement PC-232	gal.	2.40 / 2.90
Schenectady SP-7401	lb.	.29 / .31
Schwartz Vinyl Cement	qt.	1.24 / 1.50
Synvarite US #1	lb.	.195 / .215
Synvarol T	lb.	.125 / .16
T-3	lb.	.0875/ .1225
T-15, T-15D	lb.	.1275/ .1625
TN, TUN	lb.	.1325/ .1675
TN-231	lb.	.14 / .175
WR-513	lb.	.0875/ .1225
WR-515	lb.	.0825/ .1175
WR-520	lb.	.0625/ .0925
Styrofoam Adhesive #5	gal.	3.75 / 4.75
Thixon'CB	gal.	3.30 / 3.70
CB-2	gal.	3.75 / 3.95
IB	gal.	3.75 / 4.15
NB	gal.	4.05 / 4.45
NM-2	gal.	7.20 / 8.00
Urac 110	lb.	.205 / .225
115	lb.	.24 / .26
180	lb.	.095 / .12
185	lb.	.1625/ .2175
186	lb.	.0875/ .1125
192	lb.	.07

Anti-Static Agents

Anstac-2M	qt.	1.75 / 2.00
Logostat	gal.	1.35 / 1.65
Merix Anti-Static #79	qt.	.75 / 3.95
#79-OL	qt.	.75 / 3.85

Catalysts

Advance cobalt naphthenate 6%	lb.	.4825/ .5825
Cobalt tallate 6%	lb.	.4375/ .5375
Advasol	lb.	.4375/ .5375
Aritemp Curing Agent 105	lb.	2.00 / 2.25
Bakelite BH-17618	lb.	$0.33 / $0.63
BHU-53	lb.	.15 / .45
ERL series	lb.	.67 / 1.195
Cadet benzoyl peroxide, granules	lb.	.98 / 2.00
Paste	lb.	.95 / 2.25
Powder	lb.	1.50 / 2.37
Dichlorobenzoyl peroxide	lb.	3.00 / 4.25
Lauroyl peroxide	lb.	1.90 / 3.50
Methyl ethyl ketone peroxide	lb.	1.85 / 4.00
Catalyst 57	lb.	.12
196	lb.	.10
C-110, -180, -180-S, C-110-S, WF-100, -101	lb.	.12
Celanese accelerators D & E	lb.	.43 / .50
Benzol peroxide paste	lb.	2.00
Catalyst MC-1	lb.	2.25 / 2.50
Epon Curing Agent BF_3-400	lb.	4.00 / 4.50
C-111	lb.	.6225/ 1.10
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T	lb.	.80 / 1.11
U	lb.	.86 / 1.02
Z	lb.	1.265 / 1.56
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Marblette Hardener 11	lb.	1.17 / 1.65
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H C Promoter 6%	lb.	.5275/ .6275
12%	lb.	.9025/ 1.0025
Het anhydride	lb.	.55
HN 551	lb.	.95 / 1.40
901	lb.	.36 / .80
951 Ciba	lb.	.82 / 1.32
951 Furane	lb.	1.30 / 2.00
IC activators		3.00
Inhibitor	lb.	.98
Melurac 255, 259	lb.	.35
Modifier CB-110, WF-61	lb.	.15
P-27	gal.	10.00
Plaskon Hardeners, Liquid	lb.	.07
Powdered	lb.	.10 / .46
Spray dried	lb.	.10 / .25
Promoter D-2	lb.	1.60 / 2.00
Quick-Set Accelerator 804	gal.	9.80
Reichhold Hardeners 2600, 2601, 2602, 2603, 2604	lb.	.80 / 1.58
Rezolin epoxy hardeners	lb.	1.14 / 2.50
SA Hardener	lb.	.10
Soligen	lb.	.4825/ .5825

Coating Resins

Acryloids	lb.	.30 / .87
Amberlacs	lb.	.2625/ .2875
Amberols, phenolic types	lb.	.2125/ .375
Rosin maleic types	lb.	.21 / .345
Bakelite Phenolics	lb.	.28 / .64
Styrene emulsions	lb.	.1375/ .31
Vinyl acetates	lb.	.295 / .66
Solutions	gal.	5.10
Alcohols	gal.	2.27 / 2.76
Butyral resins	lb.	1.04 / 1.24
Chlorides	lb.	.41 / .61
Chloride-acetates	lb.	.38 / .66
Modified	lb.	.44 / .72
Celanese PVA emulsions, homopolymers	lb.	.17 / .26
Copolymers	lb.	.19 / .28
Chemigum latices	lb.	.46 / .60
Cymel 243-3	lb.	.38 / .385
245-8	lb.	.34 / .345
247-10	lb.	.385 / .39
248-8	lb.	.365 / .37
Dylex K-500, -600, -700, -900	lb.	$0.30 / $0.46
G-E 13110	lb.	.30 / .39
Kel-F Dispersion (dry wt.)	lb.	12.00
Ladcote FHHF-4010, FYHF-4010	lb.	.3575/ .4075
Plaskon Alkyds	lb.	.1075/ .3375
Modified	lb.	.15 / .2625
Ester Gums	lb.	.1425/ .2475
Maleics	lb.	.1825/ .275
Melamines	lb.	.195 / .435
Phenolics	lb.	.3925/ .475
Modified	lb.	.1825/ .29
Phenolic Laminating Varnishes	lb.	.165 / .27
Silicone Alkyds	lb.	1.10 / 2.40
Ureas	lb.	.195 / .435
Pliolite latices	lb.	.30 / .39
Pliolite N R	lb.	.93 / 1.22
S-3	lb.	.42 / .44
S-5	lb.	.49 / .51
Milled	lb.	.54 / .56
S-7	lb.	.88 / 1.01
Polyfluoron liquid dispersions	lb.	2.65 / 3.85
Paste dispersions	lb.	4.20 / 4.40
Primer 140	qt.	7.88 / 8.25
Reichhold Coating Resins:		
Beckacite, floor covering	lb.	.2175/ .2575
Modified phenolic	lb.	.1975/ .2475
Non-phenolic	lb.	.215 / .3175
Super, pure phenolic	lb.	.2925/ .5825
Beckamine U-F	lb.	.1975/ .35
Super, melamine	lb.	.3275/ .3975
Beckolin	lb.	.2225/ .355
Beckopol	lb.	.2525/ .2625
Beckosol Solutions, epoxy esters	lb.	.37 / .40
Modified	lb.	.18 / .23
Non-phthalic	lb.	.16 / .2325
Phenolated	lb.	.16 / .2425
Pure-drying	lb.	.1525/ .28
Non-drying	lb.	.205 / .295
Super, isophthalic	lb.	.2075/ .3025
Epoxy resin	lb.	.595 / .6975
Hard resin solutions	lb.	.115 / .195
Hydrogum	lb.	.17 / .245
Kopol	lb.	.2675/ .2725
Pentacite, non-phenolic	lb.	.17 / .2425
Plyophen phenolics, alcohol-soluble	lb.	.17 / .725
Liquid resins	lb.	.165 / .20
Powdered	lb.	.30 / .325
Solution	lb.	.2575/ .2875
Water-soluble	lb.	.111 / .30
Resin emulsions, alkyd	lb.	.23 / .27
Wallpol	lb.	.17 / .23
Styresol	lb.	.2075/ .2475
Synthe-Copal	lb.	.1625/ .20
Wallkyd	lb.	.12 / .195
Schenectady Alkyds SA Type	lb.	.3575/ .38
SE Type	lb.	.3675/ 1.435
SEA Type	lb.	.3575/ .38
Styrenated	lb.	.22 / .2625
Maleics	lb.	.1725/ .23
Phenolics	lb.	.2325/ .53
Modified	lb.	.1825/ .275
Schwartz AT-25	qt.	.63 / 1.00
BK-40	gal.	3.80 / 3.95
Versamid 100	lb.	.51 / .69
115	lb.	.64 / .82

Colors

Acheson 0100 Series Paste Dispersions:		
Blacks	lb.	.50 / .81
Blues	lb.	.55 / 2.175
Green	lb.	2.51 / 2.69
Orange	lb.	.67 / .85
Reds	lb.	1.08 / 1.34
White	lb.	.52 / .70
Yellows	lb.	.57 / .75
Advabrite M-10	lb.	2.25 / 2.40
Advance Brightener M.D.A.C	lb.	12.00 / 15.00
Akron Chemical Colors:		
Dry blends, reds	lb.	1.08 / 1.23
Yellows	lb.	.58 / .88
Organic colors, blues	lb.	.75 / 3.60
Greens	lb.	1.35 / 3.95
Reds	lb.	1.10 / 4.40
Yellows	lb.	2.00 / 5.00
Pastes, blues	lb.	1.25 / 1.58
Greens	lb.	1.85 / 1.90
Reds	lb.	1.10 / 1.40
White	lb.	.55 / .60
Yellows	lb.	1.70 / 1.75
Aquablak No. 1	lb.	.1925/ .1975
26	lb.	.1025/ .1125
41	lb.	.34 / .345
B	lb.	.0975/ .1025
G, K	lb.	.12 / .125
H	lb.	.20 / .205
L	lb.	.14 / .145
M	lb.	.105 / .11
S	lb.	.1175/ .1225
U	lb.	.225 / .23
X	lb.	.11 / .115
Cabot carbon blacks:		
Black pearls 2	lb.	.70 / .78

71	lb.	$0.32	/	$0.40
74	lb.	.24	/	.32
81	lb.	.084	/	.135
0	lb.	.12	/	.19
Carbolac 2	lb.	.70	/	.79
Elf 0	lb.	.12	/	.19
Elftex 3, 5, 8	lb.	.085	/	.135
Monarch 71	lb.	.32	/	.40
74	lb.	.24	/	.32
81	lb.	.095	/	.16
Sterling R	lb.	.0525/		.0925
S	lb.	.045	/	.0875
Supercarbovar	lb.	.47	/	.54
Cadmolith Reds	lb.	1.72	/	2.20
Yellows	lb.	1.12	/	1.20
California Ink, P. C. color dispersions:				
Black	lb.	.76	/	.77
Blues	lb.	.90	/	2.17
Brown	lb.	.56	/	.57
Green	lb.	2.05	/	2.06
Reds	lb.	.61	/	2.67
White	lb.	.72	/	.73
Yellows	lb.	.62	/	.74
P. C. plasticized boat colors:				
Black	lb.	.76	/	.77
Blue	lb.	1.32	/	1.33
Blue-green	lb.	1.21	/	1.22
Green	lb.	2.12	/	2.13
Red	lb.	2.69	/	2.70
Yellow	lb.	1.71	/	1.71
Claremont 4000-Series Pastes:				
Blacks	lb.	.82	/	1.01
Blue	lb.	.80		
Browns	lb.	.65	/	2.30
Greens	lb.	.80	/	2.15
Orange	lb.	1.58		
Reds	lb.	5.60	/	6.95
Silver	lb.	1.02		
White	lb.	.715		
Yellows	lb.	.65	/	2.87
D-Series pastes,				
Blacks	lb.	.48	/	.64
Blues	lb.	.62	/	1.57
Browns	lb.	.48	/	1.67
Golds	lb.	2.31	/	2.49
Green	lb.	1.78	/	1.88
Oranges	lb.	.71	/	4.27
Reds	lb.	1.10	/	6.36
Silver	lb.	.89	/	.91
Whites	lb.	.47	/	.60
Yellows	lb.	.56	/	3.70
K-Series pastes,				
Blacks	lb.	.56	/	.71
Blues	lb.	.89	/	1.40
Browns	lb.	.53	/	.55
Greens	lb.	.92	/	1.41
Metallics	lb.	.89	/	2.47
Orange	lb.	.86	/	4.45
Reds	lb.	.99	/	6.85
Violets	lb.	2.28	/	2.30
Whites	lb.	.59	/	.60
Yellows	lb.	.72	/	3.02
MB-Series inks:				
Black	lb.	.85		
Blue	lb.	1.25		
Clears	lb.	.65	/	.66
Green	lb.	1.30		
Metallics	lb.	1.20	/	1.25
Orange	lb.	1.05		
Pearl	lb.	1.17		
Red	lb.	1.11		
White	lb.	.68		
Yellows	lb.	.90	/	1.23
MV Series inks:				
Black	lb.	.70		
Blue	lb.	1.25		
Clears	lb.	.57	/	.62
Green	lb.	1.35		
Greengold	lb.	1.90		
Orange	lb.	.85		
Pearlescent	lb.	1.95		
Reds	lb.	1.15	/	2.95
White	lb.	.55		
Yellows	lb.	.75	/	1.35
Mylar printing inks:				
Aluminum	lb.	.99		
Black	lb.	.81		
Blue	lb.	1.18		
Bronze reducing clear	lb.	.51		
Gold concentrate	lb.	1.07		
Green	lb.	1.27		
Hi-viscosity clear	lb.	.69		
Orange	lb.	.97		
Pearlescent concentrate	lb.	1.98		
Red	lb.	1.19		
Reducing clear	lb.	.68		
White	lb.	.53		
Yellows	lb.	.83	/	1.21
PE-Series, granular concentrates:				
Blacks	lb.	.86	/	1.05
Blues	lb.	2.98		
Green	lb.	3.00		
Metallics	lb.	1.27	/	1.66
Oranges	lb.	1.12	/	2.75
Reds	lb.	1.93	/	5.25
Whites	lb.	.70	/	.85
Yellows	lb.	.78	/	5.10
PX-Series pastes:				
Black	lb.	1.58	/	1.68
Blue	lb.	2.50	/	2.60
Browns	lb.	1.08	/	1.47
Green	lb.	2.76	/	2.86
Grey	lb.	1.30	/	1.40
Ochre	lb.	1.27	/	1.37
Orange	lb.	1.48	/	1.58
Silver	lb.	$1.45	/	$1.55
White	lb.	.91	/	1.01
Yellows	lb.	1.58	/	2.55
RP-Series inks:				
Aluminum	lb.	.89		
Black	lb.	.58		
Blue	lb.	1.08		
Gold	lb.	.95		
Green	lb.	1.12		
Orange	lb.	.83		
Pearlescent	lb.	1.87		
Red	lb.	1.08		
Reducing clears	lb.	.47	/	.65
White	lb.	.49	/	
Yellows	lb.	.71	/	1.09
UR-Series pastes:				
Black	lb.	1.00		
Blue	lb.	1.82		
Brown	lb.	2.00		
Green	lb.	2.20		
Orange	lb.	1.68		
Reds	lb.	1.92	/	3.55
White	lb.	.83		
Yellows	lb.	1.75	/	2.15
VC-Series Inks:				
Black	lb.	.94		
Blue	lb.	1.20		
Clear	lb.	.49		
Green	lb.	1.30		
Metallics	lb.	1.09	/	1.45
Orange	lb.	.95		
Pearl	lb.	1.45		
Red	lb.	1.05		
White	lb.	.70		
Yellows	lb.	.85	/	.98
Coloidex No. 3	lb.	.24		
No. 8	lb.	.16	/	.23
Columbian Carbon bone blacks:				
Ivo No. 1	lb.	.1975/		.2175
3	lb.	.1875/		.2075
4	lb.	.16	/	.18
100	lb.	.2075/		.2275
359	lb.	.2025/		.2225
457	lb.	.1925/		.2125
Colloidal dispersions:				
Coacetateblak CQ-21	lb.	.875	/	.90
Coethloblak CK	lb	1.00	/	1.025
Coresinblak No.3	lb.	.76	/	.785
Costyreneblak CJ-21	lb.	.5425/		.5675
903	lb.	.595	/	.62
Covarnishblak AR	lb.	.60	/	.625
BJ	lb.	.50	/	.525
BK	lb.	.53	/	.555
Covinylblak BA	lb.	.95	/	.975
BD	lb.	.97	/	.995
BF	lb.	.70	/	.725
BH	lb.	.66	/	.685
BL	lb.	.82	/	.845
BM	lb.	.77	/	.795
CA-18	lb.	1.0725/		1.0975
Cowaxblak BV-25	lb.	.515	/	.54
CB-18	lb.	.5875/		.6125
CM-83	lb.	.485	/	.51
Continex HAF	lb.	.0725/		.13
SRF	lb.	.0525/		.11
Cyanamid inorganic pigments:				
Cobalt blues	lb.	.28	/	.35
Chrome greens	lb.	.42	/	.47
Oranges	lb.	.35		
Yellows	lb.	.35		
Iron blues	lb.	.54/		.59
Molybdate chrome oranges	lb.	.48		
Ultramarine blues	lb.	.19	/	.325
Zinc yellow	lb.	.29		
Powders, Unitane-O	lb.	.255	/	.265
Unitane-OR	lb.	.275	/	.285
Organic dyes, Indulines	lb.	.89	/	1.07
Nigrosines	lb.	.65	/	.94
Oil-soluble black	lb.	.68		
Blue	lb.	8.02		
Orange	lb.	1.06		
Reds	lb.	1.49	/	2.28
Yellows	lb.	1.21	/	4.16
Spirit-soluble black	lb.	2.95		
Brown	lb.	5.30		
Orange	lb.	5.87		
Red	lb.	6.41		
Yellows	lb.	4.62	/	4.94
Pigments, alkali blues	lb.	1.28	/	2.25
Benzidine oranges	lb.	3.15		
Yellows	lb.	.65	/	3.25
Bon reds	lb.	1.50	/	2.00
Carteret red	lb.	.93		
Chlorinated para reds	lb.	1.30		
Clarion orange	lb.	1.65		
Red	lb.	1.30		
Dinitraniline oranges	lb.	1.50		
Fugitive peacock-blue lakes	lb.	.90	/	1.17
Hansa yellows	lb.	2.20		
Lithol reds	lb.	.93	/	.98
Methyl violet toner	lb.	1.31		
Naphthol reds	lb.	.80	/	3.70
Orange lakes	lb.	.85	/	.90
PTMA blue	lb.	5.55		
Greens, Lincoln	lb.	5.30	/	6.60
Violet	lb.	4.35		
Para reds	lb.	1.15		
Phloxine toner	lb.	1.75		
Phthalocyanine blues	lb.	.90	/	4.20
Greens	lb.	3.50	/	3.95
Pigment green	lb.	1.35		
Scarlet	lb.	1.65		
Red Lake C's	lb.	1.20		
Madder	lb.	3.10		
Rhodamines	lb.	6.60		
Toluidine reds	lb.	$1.70		
Yellow lakes	lb.	1.05	/	$1.15
DC Globak	lb.	.77	/	.795
DCY Coblac	lb.	.83	/	.855
Eagle-Picher Basic carbonate White lead	lb.	.19	/	.20
Basic silicate, white lead				
201	lb.	.2075/		.2175
202	lb.	.20	/	.21
Litharge	lb.	.19		
Sublimed	lb.	.1910		
Ferro inorganic colors:				
Black	lb.	1.25	/	1.40
Blues	lb.	1.91	/	2.96
Blue-greens	lb.	1.85	/	2.85
Browns	lb.	.90	/	1.31
Oranges	lb.	2.29	/	4.20
Pink	lb.	1.77	/	1.92
Reds	lb.	2.96	/	4.75
Violets	lb.	1.89	/	2.37
Yellows	lb.	1.26	/	2.90
Harwick Stan-Tones, blues				
Dry	lb.	.90	/	3.45
GPE	lb.	2.50	/	2.85
MBS	lb.	2.20	/	4.55
PC	lb.	1.55	/	1.92
Brown, GPE	lb.	3.00		
PC	lb.	.60	/	.74
Greens, dry	lb.	.82	/	3.95
GPE	lb.	1.85	/	3.00
MBS	lb.	1.15	/	3.42
PC	lb.	1.70	/	2.32
Oranges, cadmium dry	lb.	2.10	/	5.05
Paste	lb.	2.52	/	3.32
GPE	lb.	1.20	/	1.27
MBS	lb.	1.25	/	2.82
PC	lb.	.75	/	.94
Reds, cadmium dry	lb.	2.26	/	6.15
Paste	lb.	3.25	/	4.05
Dry	lb.	.85	/	4.60
GPE	lb.	1.65	/	3.15
MBS	lb.	1.00	/	3.25
PC	lb.	1.02	/	1.52
Yellows, cadmium dry	lb.	2.80	/	3.18
Paste	lb.	1.79	/	2.21
Dry	lb.	.66	/	2.45
GPE	lb.	2.00	/	4.50
MBS	lb.	1.85	/	2.27
PC	lb.	.55	/	3.50
Hiblak AE	lb.	.095	/	.10
Interchemical IC Series				
Black	lb.	.56		
Blues	lb.	.75	/	2.10
Browns	lb.	.64	/	.69
Greens	lb.	.90	/	.99
Oranges	lb.	.78	/	.89
Reds	lb.	1.16	/	2.50
White	lb.	.70		
Yellows	lb.	.95	/	1.65
Kentucky inorganics, orange	lb.	.44	/	.64
Yellows	lb.	.31	/	.66
Organics,	lb.	3.00	/	4.15
Greens	lb.	3.50	/	4.60
Purple	lb.	1.85	/	2.05
Reds	lb.	1.95	/	3.85
Kriegr-O-Dip W Types	qt.	2.63	/	7.80
A Types	qt.	1.52	/	2.25
Laminac color pastes	lb.	.76	/	1.90
Mapico colors, black	lb.	.1475/		.15
Browns	lb.	.1575/		.16
Reds	lb.	.1425/		.145
Tans	lb.	.2325/		.235
Yellows	lb.	.12	/	.1275
Mearlmaid Pearls	lb.	14.00	/	25.00
Nacromer Pearls, Series C	lb.	2.15	/	2.25
Series W	lb.	1.50	/	1.60
Pearl Essence, nat	lb.	15.00	/	30.00
Synthetic #100	lb.	1.95		
#300	lb.	1.45		
#600, #900	lb.	2.15	/	2.45
Plastics Color Co., GP colors:				
Blacks	lb.	.75	/	3.80
Blues	lb.	.445	/	.48
Brown	lb.	1.20	/	2.25
Greens	lb.	.65	/	3.50
Reds	lb.	.65	/	3.50
Whites	lb.	.75	/	1.10
Yellows	lb.	1.15	/	1.95
Dispersant 3000	lb.	.50	/	.70
3005	lb.	.40	/	.60
3007	lb.	.80	/	1.00
3008	lb.	.55	/	.75
Polyester pastes, aqua	lb.	1.65		
Beige	lb.	1.45		
Black	lb.	1.10		
Blues	lb.	1.20	/	1.30
Brown	lb.	1.35		
Greens	lb.	1.20	/	1.70
Grey	lb.	1.30		
Ivory	lb.	1.30		
Oranges	lb.	1.80	/	2.05
Red	lb.	2.35		
White	lb.	.80		
Yellow	lb.	1.60		
Pliolite S-5 bases with pigment				
Blacks	lb.	.44	/	.49
Blues	lb.	.62	/	1.48
Greens	lb.	.54	/	.58
Oranges	lb.	.61	/	.63
Reds	lb.	.31	/	1.20
Whites	lb.	.42	/	.44
Yellows	lb.	.43	/	.45
PMS polyester colors	lb.	.85	/	2.85
Polystyrene colors	lb.	.65	/	4.30
Polysupra polyethylene blues	lb.	.65	/	5.60
Blacks	lb.	.50	/	.80

Browns	lb.	$1.48 /	$3.30
Greens	lb.	1.82 /	3.55
Ivory	lb.	.65 /	1.00
Purples	lb.	2.10 /	3.30
Reds	lb.	.70 /	6.30
Silver	lb.	1.50 /	2.95
White	lb.	.60 /	.85
Yellow	lb.	1.45 /	4.25
Polystyrene blues	lb.	.50 /	9.20
Blacks	lb.	.50 /	5.30
Browns	lb.	.95 /	2.55
Greens	lb.	.35 /	7.40
Ivory	lb.	.85 /	1.20
Reds	lb.	.35 /	6.40
White	lb.	.60 /	1.05
Yellows	lb.	1.45 /	2.95
R-B-H Plastic Powders:			
Blacks	lb.	.71 /	.79
Blues, iron	lb.	.875	
Phthalocyanines	lb.	2.73	
Browns	lb.	.61 /	.8
Greens, chrome	lb.	.855	
Phthalocyanines	lb.	2.34	
Orange	lb.	.87	
Purple	lb.	3.00	
Red	lb.	1.93	
Whites	lb.	.71 /	.74
Yellow	lb.	.81	
Resin Plasticizer Pastes:			
Blacks	lb.	.505 /	.65
Blue	lb.	1.59	
Green	lb.	1.58	
Orange	lb.	.665	
Reds	lb.	1.15 /	2.24
White	lb.	.50	
Yellows, cadmium	lb.	1.20	
Chrome	lb.	.545	
Vinyl Extrusion Chips:			
Blacks	lb.	.975 /	1.04
Blues, iron	lb.	.90 /	1.08
Phthalocyanine	lb.	2.50	
Brown	lb.	.86	
Green, chrome	lb.	.96	
Phthalocyanine	lb.	2.51	
Oranges	lb.	.875 /	.92
Purple	lb.	3.41	
Reds	lb.	1.38 /	2.02
White	lb.	.78	
Yellow	lb.	.845	
R-C blacks	lb.	5.50 /	21.30
Browns	lb.	4.375 /	15.75
Reds	lb.	.28 /	15.05
Yellows	lb.	3.60 /	14.05
Reichhold inorganic pigments:			
Blues, iron	lb.	.53	
Milori, pre-wet	lb.	.3625	
Greens, chrome	lb.	.42 /	.44
Reduced 25%	lb.	.19	
Oranges, chrome	lb.	.35	
Molybdate	lb.	.48	
Yellows, chrome	lb.	.35	
Zinc	lb.	.29 /	.34
Rez-N-Dye (dry wt.)	lb.	7.50	
Saran colors	lb.	.59 /	1.80
Sherwin-Williams Dispersed Colors	lb.	.55 /	1.97
Inorganic colors, oranges, yellows	lb.	.32 /	.45
Organic colors, blues	lb.	.90 /	3.60
Greens	lb.	1.35 /	3.95
Reds	lb.	.85 /	4.40
Yellows	lb.	.55 /	1.97
Vansul Organic Drys			
Blues	lb.	3.45 /	3.60
Greens	lb.	1.35 /	3.95
Oranges	lb.	2.21 /	3.00
Reds	lb.	.90 /	4.40
Yellows	lb.	2.00 /	2.25
VAP Dry Dispersions			
Black	lb.	1.00	
Blues	lb.	2.90 /	3.60
Greens	lb.	3.20 /	4.05
Oranges	lb.	1.45 /	2.55
Reds	lb.	1.70 /	4.45
Yellows	lb.	1.35 /	2.55
VP-Series Pastes			
Black	lb.	.70	
Blue	lb.	1.65	
Brown	lb.	1.55	
Green	lb.	2.05	
Oranges	lb.	.80 /	2.30
Reds	lb.	1.15 /	2.55
White	lb.	.47 /	.65
Yellows	lb.	.60 /	1.65
VPE-Series Pastes			
Black	lb.	.90	
Blue	lb.	1.85	
Green	lb.	2.10	
Orange	lb.	1.00	
Reds	lb.	1.45 /	2.30
White	lb.	.90	
Yellows	lb.	1.60 /	2.00
VV Chips			
Blacks	lb.	.90 /	1.30
Blues	lb.	1.00 /	2.25
Brown	lb.	1.60	
Greens	lb.	.90 /	2.45
Oranges	lb.	1.00 /	2.15
Reds	lb.	1.40 /	2.70
White	lb.	.65	
Yellows	lb.	.85 /	1.80
Vinylized colors, blacks, whites	lb.	.755	
Blues	lb.	1.16 /	1.18
Golds	lb.	1.51 /	1.57
Green	lb.	1.45	
Metallic	lb.	1.15	
Orange	lb.	.83	
Reds	lb.	$1.15 /	$2.27
Yellows	lb.	.76 /	1.09
Violite 199, green	lb.	2.95	
200, yellow	lb.	3.75	
PL 3-60, blue	lb.	3.25	
18-70, blue	lb.	3.70	
Williams colors & pigments:			
Blacks, iron oxide	lb.	.1425/	.145
Browns, iron oxide	lb.	.1525/	.155
Burnt umbers	lb.	.0775/	.095
Greens, chromium oxide	lb.	.42 /	.4875
Reds, 100 series, 1,000 series, RY series	lb.	.1375/	.14
Kromas	lb.	.1375/	.15
Yellows, iron oxide	lb.	.115 /	.1225
Witcoblak 12	lb.	.0725/	.14
32	lb.	.1225/	.20
50	lb.	.0975/	.175
100	lb.	.26 /	.34
Pellets	lb.	.26 /	.34
F-1	lb.	.0575/	.12
Hitone	lb.	.36 /	.44
Pellets	lb.	.36 /	.44
Zopaque, anatase	lb.	.225 /	.235
Rutile	lb.	.245 /	.255

Dispersing Agents

Daxads	lb.	.08 /	.40
Tamol 731	lb.	.185 /	.1875

Fillers

Advaresin CXF	lb.	.49 /	.55
KF	lb.	.38 /	.44
A. F. D.	ton	26.50 /	60.00
Albacar 5950, 5960, 5970	ton	50.00 /	55.00
Aluminum Flake	ton	23.50 /	30.00
Anhydrous calcium sulfate, W-1320	ton	47.00 /	52.00
Atomite	ton	32.50	
Barytes, No. 1	ton	45.00 /	65.75
Burgess Iceburg Pigment	ton	50.00	
Pigment No. 30	ton	37.00	
Cab-o-sil	lb.	0.68 /	0 75
Calcene NC	lb.	.036 /	.059
TM	lb.	.0375/	.0625
Camel—CARB	ton	12.00	
—TEX	ton	20.00	
—WITE	ton	32.50	
Cotton flocks	lb.	.12 /	.32
Crown Clay	ton	14.00	
Dixie Clay	ton	14.00 /	34.50
Duramite	ton	20.00	
English Mica:			
Waterground mica 160 mesh	lb.	.08 /	.0875
325 mesh	lb.	.0825/	.09
Georgia Kaolin clays:			
Hydrite	ton	26.00	
Flat	ton	25.00	
PD-10	ton	49.00	
PD-121	ton	20.00	
PX	ton	41.00	
Harwick fillers:			
Clays, Champion	ton	14.00 /	36.00
Harwick	ton	20.50 /	55.50
Flock, white	lb.	.11 /	.28
Colored	lb.	.11 /	.19
Magnesium carbonate	lb.	.105 /	.13
Magnesia, tech	lb.	.055 /	.345
Mica, Silversheen	lb.	.08 /	.0875
Pecan shell flour	ton	45.00 /	106.00
Stan white 325	ton	11.50 /	23.50
Walnut shell flours:			
100W, 200WD	ton	50.00 /	60.00
200W	ton	60.00 /	70.00
200WB	ton	62.00 /	72.00
325W	ton	74.00 /	84.00
Hi-Sil 101	lb.	.10 /	.155
233	lb.	.09 /	.105
Kalite	ton	50.00 /	65.00
Kaolloid	ton	10.50	
Laminar	lb.	.015	
Maglite	lb.	.2525/	.26
Marinco	lb.	.105 /	.13
McMamee Clay	ton	13.50 /	33.00
Minerals & Chemical Corp.:			
Edgar ASP 200	ton	43.00	
ASP 400	ton	24.00	
ASP 600	ton	25.00	
ASP 900	ton	19.50	
ASP 1300	ton	80.00	
Multiflex MM	ton	110.00 /	125.00
Nytal 200L	ton	27.00 /	50.00
300	ton	37.00 /	60.00
Secco Clay	ton	12.00	
Silene EF	lb.	.06 /	.105
Sno-Brite Clay	ton	12.50	
Snowflake	ton	20.00	
Sparmite	ton	80.00 /	105.00
Surtex MM	ton	37.00 /	52.00
Suspenso	ton	33.00 /	48.00
Tamms Satin Talc	ton	22.50 /	46.00
Velveteen R Silica	ton	23.00 /	28.00
U.S. Mica, dry grind	lb.	.04 /	.065
Witcarb P	ton	110.00 /	140.00
R	ton	120.00 /	150.00
Regular	ton	56.75 /	85.00
Wollastonite F-1	ton	23.00 /	25.00
P-1	ton	25.00 /	27.00

Finishes

Logoquant colors	gal.	$3.25 /	$6.30
Toy gloss, acetate	gal.	2.35 /	4.30
Metal	gal.	2.45 /	4.10
Polystyrene	gal.	2.45 /	4.70

Flame-Proofing Agents

IC-776 Antimony Concentrate	lb.	.495 /	.51
M&T Antimony oxide	lb.	.27 /	.285

Glass Reinforcements

Chrome 60-end Roving:			
FBF-7.1, -7.3	lb.	.40 /	.44
FBF-7.5, -7.7	lb.	.42 /	.46
Garan 60-end Roving:			
FBF-7.2, -7.4	lb.	.42 /	.46
FBF-7.6, -7.8	lb.	.44 /	.48
Vitron 60-end Roving:			
VR-12	lb.	.48 /	.52

Lubricants

Advawax 280	lb.	.365 /	.39
Baselube	qt.	2.50 /	4.00
DC-36 Emulsion	lb.	1.36 /	2.50
Garalease 915	gal.	3.80 /	4.50
GE silicone-emulsions	lb.	1.22 /	1.40
HSC #35, 362, 515	lb.	1.22	
IC-500	gal.	2.50	
-571	gal.	3.25	
-793-10	gal.	3.40	
IMS neutral oil spray	can	1.37 /	2.00
Lubrex	lb.	.27 /	.32
Lunn-Lease	gal.	4.15 /	4.85
M-1 Mold Release	lb.	3.00 /	4.00
Metasap barium stearate	lb.	.37 /	.42
Calcium 627	lb.	.36 /	.41
Stearate	lb.	.35 /	.40
Magnesium stearate	lb.	.38 /	.43
ML-4 Separating Film	lb.	.30 /	.40
Mold-Ease Concentrate PCR	qt.	2.50 /	5.85
Mold Release 225	gal.	5.25 /	6.00
235	gal.	6.00	
Mold-Wiz	gal.	4.00 /	6.00
Part-A-Part	gal.	3.05 /	3.75
Partingkote 823	qt.	1.18 /	2.18
Prepoxy	gal.	7.20 /	12.80
Plaskon 8406, 8407	lb.	.30 /	.37
8416, 8417	lb.	.35 /	.42
8429	lb.	.40 /	.47
Releasor Wax No. 826	lb.	2.29	
Slide	20 oz.	1.25 /	2.00
Sprits	lb.	1.00 /	1.25
SS-452	gal.	2.80 /	4.90
Super King Bomb-Lube	20 oz.	1.75 /	2.50
Toplube	qt.	2.50 /	4.00
Vibrin-VPA Parting Agent	gal.	4.25 /	4.65

Mica

Dry Ground Mica	lb.	.04 /	.065
Mycalex 385 & 400, rods, 18 in. length		.90 /	3.35
Sheets, 14 x 18 inches		5.70 /	22.40
K, rods, 18-in. length		1.80 /	6.70
Sheets, 14 x 18 inches		11.40 /	44.80
Supramica 500, rods, 18-in. length		1.08 /	4.02
Sheets, 14 x 18 inches		6.84 /	26.88
Waterground Mica	lb.	.08 /	.09

Miscellaneous

Dutch Boy Bentone	lb.	.44 /	.60
Ben-A-Gel	lb.	.98 /	1.40
Metasap Water Proofing Agent 569	lb.	.21	
PMS Purging Compound	lb.	.35	
Ultra violet absorber #9	lb.	5.25 /	5.75

Plasticizers

Adipol 2EH, 10A, 810, XX	lb.	.40 /	.435
BCA	lb.	.43 /	.455
ODY	lb.	.45 /	.485
Admex 710	lb.	.3325/	.36
711	lb.	.3525/	.38
744, 745	lb.	.3925/	.42
760	lb.	.5725/	.60
761	lb.	.4425/	.47
Akron MP	lb.	.305 /	.0755
Battett dibutyl phthalate	lb.	.30 /	.335
Dimethyl phthalate	lb.	.28 /	.315
Plasticizer 136	lb.	.175 /	.21
Benzoflex 2-45	lb.	.26 /	.29
9-88	lb.	.32 /	.35
Cabflex DDA, Di-OA, DOA, ODA	lb.	.425 /	.455
DDP, Di-OP, DOP, ODP	lb.	.305 /	.335
Di-BA	lb.	.4325/	.4625
Di-OZ	lb.	.48 /	.51

HS-10	lb.	$0.44 /	$0.47
TCP	lb.	.345 /	.375
Chlorowax 40	lb.	.1525/	.1825
50	lb.	.1675/	.1875
70	lb.	.185 /	.25
70-S	lb.	.21 /	.275
LV	lb.	.1725/	.2025
Columbian Carbon butyl stearate	lb.	.2325/	.3225
Capryl alcohol	lb.	.195 /	.30
Caprylene	lb.	.10 /	.205
Dibenzyl sebacate	lb.	.92 /	1.01
Dibutyl phthalate, dihexyl phthalate	lb.	.30 /	.395
Dibutyl sebacate, CP	lb.	.665 /	.755
Dicapryl phthalate	lb.	.27 /	.36
Dihexyl adipate, diisooctyl adipate, dioctyl adipate	lb.	.40 /	.495
Dihexyl sebacate	lb.	.65 /	.74
Diisodecyl phthalate	lb.	.29 /	.385
Diisooctyl phthalate, dioctyl phthalate	lb.	.28 /	.375
Dimethyl sebacate	lb.	1.30 /	1.39
Dioctyl sebacate	lb.	.60 /	.69
Harchemex	lb.	.24 /	.345
Harflex 300	lb.	.58 /	.675
325	lb.	.4325/	.52
500	lb.	.315 /	.41
Isooctyldecyl phthalate	lb.	.285 /	.38
Methyl ethyl ketone	lb.	.26 /	.365
Sebacic acid, CP	lb.	.77 /	.89
Purified	lb.	.69 /	.81
Conoco H-300	lb.	.06 /	.10
Darex DIBA	lb.	.4325/	.4625
DIBM	lb.	.32 /	.3475
DIBP	lb.	.30 /	.33
DODA, DIOA	lb.	.425 /	.455
DIDP, DIOP, DOP, DOP-HR, IOIDP	lb.	.305 /	.335
Dinopol 235	lb.	.355 /	.39
IDO	lb.	.285 /	.32
MOP	lb.	.325 /	.36
Dow Plasticizer No. 5	lb.	.315 /	.54
Resin 276-V2,-V9	lb.	.265 /	.325
Drapex 3.2	lb.	.40 /	.49
Drew DP-100, DP 200	lb.	.425 /	.46
DP-250	lb.	.435 /	.47
DP-316	lb.	.30 /	.335
DP-317	lb.	.5625/	.5975
DP-520	lb.	.4225/	.4575
SC	lb.	.44	
Dutch Boy Plasticizer NL-A10 (DBP)	lb.	.30	.33
NL-A20 (DOP), NL-A30 (DIOP)	lb.	.305 /	.335
NL-C20 (DOS)	lb.	.61 /	.63
NL-F21	lb.	.395 /	.425
NL-F31	lb.	.44 /	.47
NL-F41	lb.	.48 /	.51
NL-A54	lb.	.295 /	.325
Eastman di(2 ethyl hexyl) adipate, P.E.	lb.	.40 /	.435
Di (2 ethyl hexyl) azelate	lb.	.455 /	.49
Di-(2 ethyl hexyl) phthalate	lb.	.28 /	.315
Di(methoxy ethyl) phthalate	lb.	.425 /	.46
Diisobutyl adipate	lb.	.41 /	.445
Dibutyl phthalate	lb.	.30 /	.335
Diethyl phthalate	lb.	.275 /	.31
Diisobutyl phthalate	lb.	.29 /	.325
Dimethyl phthalate	lb.	.28 /	.315
Plasticizer 84	lb.	.27 /	.305
Triacetin	lb.	.365 /	.40
Tributyrin	lb.	.69	
Elastex 10-P, 28-P	lb.	.28 /	.315
18-P	lb.	.285 /	.32
20-A, 60-A	lb.	.40 /	.435
40-P, 48-P	lb.	.27 /	.305
50-B	lb.	.265 /	.30
80-P	lb.	.275 /	.31
90-P	lb.	.29 /	.325
DCHP, cast solid	lb.	.58 /	.59
Granular	lb.	.595 /	.605
Ethox	lb.	.50 /	.525
Flexol 3GH	lb.	.44 /	.46
3G0	lb.	.53 /	.55
4G0	lb.	.325 /	.35
8N8	lb.	.355 /	.38
10-10, 10-A	lb.	.29 /	.315
77-G, 426	lb.	.27 /	.295
380	lb.	.305 /	.33
810	lb.	.285 /	.31
A-26	lb.	.40 /	.425
B-400	lb.	.25 /	.275
CC-55	lb.	.305 /	.33
DOP	lb.	.28 /	.305
R2H	lb.	.59	
TOF	lb.	.43 /	.455
Flexricin 66	lb.	.3275	
P-4		.30	
P-6	lb.	.37	
P-8	lb.	.32	
Good-Rite GP-233, -235, -236	lb.	.40 /	.435
GP-261	lb.	.285 /	.32
GP-265	lb.	.29 /	.325
GP-266	lb.	.295 /	.33
Harflex 10	lb.	1.25 /	1.335
40	lb.	.64 /	.725
50, 80	lb.	.58 /	.665
60	lb.	.62 /	.705
90	lb.	.88 /	.965
120, 150	lb.	.305 /	.395
140, 160	lb.	.30 /	.39
180	lb.	.295 /	.38
220, 250	lb.	$0.425 /	$0.515
260, 280	lb.	.42 /	.51
300	lb.	.58 /	.67
500	lb.	.315 /	.405
Harchem butyl stearate	lb.	.2275/	.3125
Sebacic acid, CP	lb.	.67 /	.79
Purified	lb.	.59 /	.71
Kapsol	lb.	.33 /	.355
Kesscoflex BCL	lb.	.365 /	.375
BCO	lb.	.355 /	.365
BCP	lb.	.33 /	.36
BCS	lb.	.305 /	.315
BO	lb.	.26 /	.28
BS	lb.	.235 /	.26
DBT	lb.	.64	
DDA, DIOA, DOA	lb.	.40 /	.435
DOZ	lb.	.46 /	.50
MCO	lb.	.3225/	.3525
MCP	lb.	.37 /	.40
MCS	lb.	.33 /	.34
ODA	lb.	.47 /	.50
TRA	lb.	.37 /	.40
KP-23	lb.	.29 /	.325
-90	lb.	.40 /	.435
-140	lb.	.46 /	.485
-201	lb.	.58 /	.59
-220	lb.	.32 /	.355
-555	lb.	.565 /	.57
Kronisol	lb.	.33 /	.365
Kronitex AA, I, K-3, MX	lb.	.325 /	.36
Methox	lb.	.385 /	.41
Monoplex DBS	lb.	.64 /	.665
DCP	lb.	.2925/	.32
DOS	lb.	.58 /	.605
S-38	lb.	.215 /	.24
S-70	lb.	.3925/	.42
S-71	lb.	.45 /	.475
Monsanto dibutyl phthalate	lb.	.30 /	.33
Diethyl phthalate	lb.	.25 /	.28
Dimethyl phthalate	lb.	.275 /	.305
Diphenyl phthalate	lb.	.5175/	.5375
DIDA, DOA	lb.	.425 /	.455
DIDP, DIOP, DOP	lb.	.305 /	.335
HB-20	lb.	.15 /	.17
HB-40	lb.	.22 /	.24
Orthonitrobiphenyl	lb.	.13 /	.15
Tricresyl phosphate	lb.	.325 /	.36
Triphenyl phosphate	lb.	.39 /	.40
Morflex P-50	lb.	.68 /	.71
Naugatuck decylbutyl phthalate	lb.	.27 /	.30
Dibutyl phthalate	lb.	.30 /	.33
Sebacate	lb.	.645 /	.67
Diisooctyl adipate, dioctyl adipate	lb.	.425 /	.455
Diisooctyl phthalate, dioctyl phthalate, Isooctyl decyl phthalate	lb.	.305 /	.335
Dinonyl adipate	lb.	.445 /	.475
Dioctyl sebacate	lb.	.585 /	.61
Epoxy plasticizer	lb.	.335 /	.36
Tricresyl phosphate	lb.	.345 /	.375
Ohio-Apex butyl oleate	lb.	.2325/	.265
Stearate	lb.	.22 /	.255
Diallyl phthalate	lb.	.49 /	.525
Dibutyl phthalate	lb.	.30 /	.335
Di-Carbitol phthalate	lb.	.40 /	.425
Diisobutyl adipate	lb.	.41 /	.445
Diisodecyl phthalate	lb.	.305 /	.34
Dioctyl phthalate	lb.	.305 /	.34
D.I.O.P.	lb.	.305 /	.34
Tributyl phosphate	lb.	.50 /	.535
Ohopex Q-10	lb.	.295 /	.33
R-9	lb.	.3525/	.3775
Paraplex S-B	lb.	.29 /	.3475
AL-111	lb.	.32 /	.3275
G-20	lb.	.76 /	.7675
G-25	lb.	.76 /	.77
G-40	lb.	.4825/	.51
G-50	lb.	.39 /	.4175
G-53	lb.	.4325/	.46
G-60, -61	lb.	.3325/	.36
G-62	lb.	.3525/	.38
RG-2	lb.	.41 /	.6575
RG-7	lb.	.33 /	.335
RG-8	lb.	.505 /	.5125
RG-10	lb.	.52 /	.5275
Pfizer acetyl tributyl citrate, tech	lb.	.32 /	.57
Acetyl triethyl citrate, tech	lb.	.36 /	.57
Triethyl citrate	lb.	.4575/	.58
Plasticizer 1	lb.	1.17 /	1.37
Plasticizer 120	lb.	.44 /	.49
Plastoflex #3	lb.	.52 /	.57
#520	lb.	.36 /	.435
DBE	lb.	.50 /	.55
MGB	lb.	.29 /	.37
VS	lb.	.3575/	.3975
Plastolein 9050 DHZ	lb.	.52 /	.56
9055 DGP	lb.	.28 /	.32
9057 DIOZ	lb.	.455 /	.50
9058 DOZ	lb.	.455 /	.50
9250 THFO	lb.	.3575/	.4025
9404 TGP	lb.	.3725/	.4175
9715 & 9720 Polymeric	lb.	.365 /	.41
Polycizer 162, 562, 662	lb.	.285 /	.445
332, 532, 632	lb.	.40 /	.555
Polycon #7, 9, 10, 11	lb.	.305 /	.335
#30	lb.	.30 /	.33
#31	lb.	.27 /	.30
#40	lb.	.245 /	.275
PX-104	lb.	.30 /	.33
-108, -118, -120, -138	lb.	.305 /	.335
-114	lb.	.27 /	.30
-208, -220, -238	lb.	.425 /	.455
-404	lb.	.645 /	.67
-438	lb.	.585 /	.61
-800	lb.	$0.325 /	$0.35
-917	lb.	.33 /	.36
Pycal 40	lb.	.3875/	.4375
60	lb.	.60 /	.635
62	lb.	.80 /	.835
94	lb.	.3275/	.3725
140	lb.	.35 /	.40
170	lb.	.275 /	.325
194	lb.	.2775/	.3225
R C Plasticizers: B-17	lb.	.21 /	.33
BD-8	lb.	.38 /	.50
BIDP	lb.	.27 /	.42
DBP	lb.	.30 /	.44
DIDA, DIOA, DOA	lb.	.425 /	.56
DIDP, DIOP, DOP, ODP	lb.	.305 /	.45
DIOS, DOS	lb.	.58 /	.71
O-16	lb.	.275 /	.395
TG-8	lb.	.31 /	.43
TG-9	lb.	.41 /	.53
Santicizer 1-H	lb.	.50 /	.51
3	lb.	.46 /	.47
8	lb.	.43 /	.44
9	lb.	.39 /	.42
140	lb.	.325 /	.36
141	lb.	.34 /	.37
160	lb.	.25 /	.28
601	lb.	.32	
602	lb.	.305	
B-16	lb.	.4875/	.4975
E-15	lb.	.5075/	.5375
M-17	lb.	.4275/	.4575
Staflex AX	lb.	.43	
BR	lb.	.26 /	.29
CP	lb.	.28 /	.31
DBES, DOS	lb.	.61 /	.635
DIOA, ODA	lb.	.435 /	.465
DIOP, DOP, MP	lb.	.305 /	.335
DOZ	lb.	.48 /	.5075
IXA	lb.	.32 /	.35
KA	lb.	.36 /	.3875
KD	lb.	.44 /	.4675
Witcizer #100	lb.	.26 /	.27
#101	lb.	.31 /	.32
#200	lb.	.195 /	.205
#201	lb.	.235 /	.245
#300	lb.	.30 /	.33
#312, 313	lb.	.305 /	.33
#412	lb.	.435 /	.465

Resins & Molding Compounds

Acrylic

Cadco cast rods	lb.	1.42 /	6.96
Polished	lb.	1.58 /	7.16
Machined rods	ft.	22.00 /	89.54
Tubes	lb.	1.39 /	5.76
Polished	lb.	1.51 /	5.99
Colors	lb.	1.62 /	5.99
Pearl	lb.	1.99 /	6.76
Lucite injection molding powders:			
Colorless, transparent	lb.	.55	
Std. colors	lb.	.59 /	1.00
Stock colors	lb.	.59 /	.84
Granular Powders for compression & extrusion	lb.	.51 /	.75
Plexiglas molding powders:			
Colorless	lb.	.55 /	.80
Colors, stock	lb.	.59 /	.84
Custom	lb.	.59 /	1.00
Sheets, Types I-A & II			
Colorless	sq. ft.	.80 /	22.18
Colors	sq. ft.	.88 /	1.10
Type R, Colorless	sq. ft.	.60 /	12.64
Colors	sq. ft.	.69 /	1.07
Polycast 1	sq. ft.	.80 /	2.40

Alkyd

Plaskon foundry resin 580-11L	lb.	.245 /	.275
Molding Compound, Type 411	lb.	.43 /	.60
Type 413, 417	lb.	.57 /	.74
Type 420 black	lb.	.44 /	.695
Type 422 colored	lb.	.51 /	.695
Mottle	lb.	.52 /	.705
Natural	lb.	.49 /	.60
Type 430	lb.	.34 /	.50

Cellulosic

Cellulose acetate:			
Celanese cast & extruded film:			
Standard length rolls, clear	lb.	.67 /	1.01
Colors	lb.	.93 /	1.19
Matte finish	lb.	1.43 /	1.77
Stock & cut sheets, clear	lb.	.033 /	.11
Colors	lb.	.044 /	.136
Matte finish	lb.	.087 /	.162
Celanese cast sheeting:			
Standard length rolls, clear	M. sq. in.	.129 /	1.47
Matte finish	M. sq. in.	.16 /	.657
Tinted	M. sq. in.	.243 /	.722
Stock & cut sheets, clear	M. sq. in.	.145 /	1.55

Matte finish	M. sq. in.	$0.183 / $0.767
Tinted	M. sq. in.	.259 / .862
Hercocel A, extrusion & injection	lb.	.50 / .65
Injection, std. colors	lb.	.46 / .61
Special colors	lb.	.42 / .45
Tenite Acetate, Group 1	lb.	.50 / .59
Group 2	lb.	.46 / .55
Group 3	lb.	.41 / .51
Group 4	lb.	.38 / .49
Group 5	lb.	.65 / .75
Lumarith molding compounds:		
Group I	lb.	.50 / .59
Group II	lb.	.46 / .55
Group III	lb.	.38 / .48
Non-stock extruded rolls, clear	M. sq. in.	.13 / 1.28
Colors	M. sq. in.	.16 / 1.50
Extruded sheets, clear	M. sq. in.	.15 / 1.95
Colors	M. sq. in.	.17 / 2.13
Stock extruded rolls, clear	M. sq. in.	.13 / .88
Colors	M. sq. in.	.16 / .91
Extruded sheets, clear	M. sq. in.	.15 / 1.67
Colors	M. sq. in.	.17 / 1.67
Cellulose acetate butyrate:		
Tenite butyrate	lb.	.62 / .71
A pearls	lb.	.72 / .81
Blacks, reprocessed	lb.	.50 / .58
Cellulose propionate:		
Forticel	lb.	.63 / .71
Essence pearls	lb.	.73 / .81
Reprocessed blacks	lb.	.51 / .58
Ethyl cellulose:		
Dyeform 720, 721	lb.	1.29 / 1.52
Ethocel PG	lb.	.72 / .80
Bulk, reg.	lb.	.66 / .81
Std., 7 cps.	lb.	.71 / .86
Hercocel E	lb.	.72 / .88

Epoxy

Araldite 502, 6010, 6020	lb.	.80 / .995
504	lb.	.77 / .965
551, 6060	lb.	.75 / .95
6030, 6040	lb.	.885 / .995
Bakelite ERL series	lb.	.80 / .995
Epocast 2, 3, 5	lb.	1.33 / 1.77
4-B-2, 4-B, 4-C, 4-C-T, 4-D, Paste	lb.	1.15 / 1.55
Epon 562	lb.	1.52 / 1.77
815	lb.	.80 / .99
820, 828	lb.	.80 / .97
834	lb.	.855 / 1.00
864	lb.	.91 / 1.06
864-C-75	lb.	.73 / .85
1001	lb.	.615 / .85
1004	lb.	.595 / .6025
1007	lb.	.605 / .6125
1009	lb.	.69 / .6975
Furane CN-502	lb.	1.33 / 1.77
Jet-Kote (with cat.)	gal.	7.50 / 10.00
Maraset 602, 610, 610V, 612B	lb.	1.25 / 1.70
613, 648	lb.	1.17 / 1.40
604A, 607	lb.	1.17 / 1.65
608	lb.	1.32 / 1.77
614A, 631A, 618A, 640	lb.	1.15 / 1.70
645	lb.	
Reichhold Polytool Resins:		
6125, 6130, 6140	lb.	.80 / 1.58
Rezolins A & B	lb.	1.29 / 1.74
Toolplastik packages.		
L-900, L-930	lb.	1.59 / 2.29
L-902	lb.	1.69 / 1.84
L-904	lb.	1.54 / 2.19
L-910	lb.	1.94 / 2.34
L-914	lb.	1.83 / 2.19
L-931	lb.	1.75 / 1.99
L-940	lb.	2.05 / 2.29

Fluorocarbon

Bakelite FGBB-33789, FGEB-34700, FXMA-50590, FXMB-50344	lb.	9.00 / 10.00
FGEB-32788, FXMB-50090	lb.	12.00 / 14.00
FYTD	lb.	11.00 / 13.00
FYTH, FYTS	lb.	8.50 / 9.50
Kel-F Grade 270, 300		
High density	lb.	6.50 / 9.00
Low density	lb.	6.00 / 8.50
Grade 300—P-25		
High density	lb.	7.50 / 10.00
Low density	lb.	7.00 / 9.50
Grade 500-F, 500-R		
High density	lb.	7.00 / 9.50
Low density	lb.	6.50 / 9.00
Polyfluoron, high density crystals & pellets	lb.	9.00 / 9.50
Colors	lb.	9.50 / 10.00
Low density powder	lb.	8.50 / 9.00
Dispersion grade	lb.	10.50 / 11.00
Teflon 1	lb.	4.50 / 5.55
5	lb.	4.75 / 5.80
6	lb.	7.45 / 8.00
30 aqueous dispersion	lb.	5.60 / 6.85

Melamines

Fiberite 2015 (black & pastels)	lb.	.57 / .62
Pelleted	lb.	$0.61 / $0.66
Cymel 402	lb.	.51 / .53
404R, 404T	lb.	.85 / .95
405	lb.	.45 / .52
428	lb.	.48 / .55
430	lb.	.465 / .535
440	lb.	1.10
480	lb.	.265 / .315
1077, 1079	lb.	.45 / .75
Ungranulated	lb.	.43 / .73
1500	lb.	.42 / .55
1502	lb.	.45 / .58
3020	lb.	.57 / .72
3024-A	lb.	.67
3135	lb.	.85 / 1.05
3136	lb.	1.05 / 1.15
P-592, -592-A	lb.	.65 / .75
Plaskon	lb.	.44 / .75

Phenolic

91-LD	lb.	1.50 / 2.50
Admirez PL-50	lb.	.215
UP-11	lb.	.2325
Bakelite general purpose	lb.	.187 / .3525
BMG-5000	lb.	.19 / .30
Colors	lb.	.2375/ .435
Chem. resist.	lb.	.23 / .40
Electrical Insul.	lb.	.2725/ .4125
Heat resist.	lb.	.19 / .35
Impact resist.	lb.	.24 / .4025
Barrett foundry resins, liquid	lb.	.2125/ .2425
Powdered	lb.	.27 / .355
Insulation resins	lb.	.15 / .175
Molding resin 313, 314, 317	lb.	.27 / .285
316	lb.	.295 / .31
1502, -3, -4, -5, R-110R	lb.	.25 / .265
R-114	lb.	.285 / .30
Corfoam 107, 114	lb.	.55 / .82
Cyacor 151	lb.	.215 / .235
191	lb.	.13 / .16
Durez, heat resist.	lb.	.19 / .245
Impact resist.	lb.	.24 / .63
Insulation	lb.	.21 / .305
Non-Bleed	lb.	.19 / .195
Special	lb.	.19 / .665
Std.	lb.	.19 / .245
Durite GP	lb.	.195 / .24
HR	lb.	.191 / .3025
IM	lb.	.24 / .415
SG	lb.	.195 / .3575
Dyform	lb.	1.10 / 1.35
Fiberite 1078	lb.	.42 / .43
1087, 1165, 1270, 1271, 1330, 1332, 1347, FM 1132, FM 3510	lb.	.39 / .395
1153	lb.	.455 / .46
1167	lb.	.3875/ .3925
1340	lb.	.4275/ .4325
1346	lb.	.44 / .4475
4010	lb.	.68
4020	lb.	.815 / .82
FM 926	lb.	.43 / .435
927	lb.	.41 / .415
1914	lb.	.375 / .38
1957	lb.	.445 / .45
1996	lb.	.375 / .38
10365	lb.	.5225/ .5275
11547	lb.	1.05 / 1.06
11678	lb.	.52 / .525
14111	lb.	.415 / .42
17067	lb.	.851 / .82
17610	lb.	1.05 / 1.06
Fiberite 1078	lb.	.425 / .435
1087, 1165, 1270, 1271, 1330, 1332, 1347, 1389, FM-1132, FM-3510, FM-3515	lb.	.395 / .40
1153 (red only)	lb.	.46 / .465
1167	lb.	.3925/ .3975
1333, FM-10365, FM-11678	lb.	.67 / .675
1346, FM-927	lb.	.415 / .42
1346 (red only)	lb.	.445 / .452
4030-190	lb.	.78 / .81
4031	lb.	.625 / .63
FM-926	lb.	.435 / .44
FM-1132 (pellets), FM-14111	lb.	.42 / .425
FM-1914, FM-1996	lb.	.38 / .385
FM-11547, FM-17610	lb.	1.07 / 1.08
FM-11679	lb.	1.29 / 1.30
FM-17067	lb.	.83 / .835
G-E molding powders:		
12401	lb.	.31 / .41
13408, 12486	lb.	.205 / .215
12410, 12420	lb.	1.50 / 1.60
12432	lb.	.405 / .505
12433	lb.	.565 / .665
12435	lb.	.25 / .35
12439-A, 12466	lb.	.265 / .365
12444	lb.	.435 / .535
12463	lb.	.415 / .515
12467	lb.	.51 / .61
12487, 12489, 12884, 12887	lb.	.365 / .465
12491, 12493, 12853, 12900, 12901, 12902, 12920, 12921	lb.	.21 / .31
12494	lb.	.385 / .485
12808	lb.	.50 / 60
12809	lb.	.66 / 76
12871-A	lb.	.22 / .32
12824	lb.	$0.505 / $0.605
12841, 12906	lb.	.255 / .355
Loven LHR-401, -403	lb.	.225 / .23
-407, -409	lb.	.60 / 1.00
-408	lb.	.25 / .255
LI-201	lb.	.39 / .40
-207	lb.	.475 / .48
-209	lb.	.60 / 1.00
-212	lb.	.425 / .43
LM-110, -119	lb.	.19 / .195
-101	lb.	.24 / .245
-116	lb.	.255 / .26
-117	lb.	.225 / .23
-118	lb.	.1975/ .2025
LMI-301	lb.	.2525/ .2575
-303	lb.	.345 / .35
-304	lb.	.60 / 1.00
-307	lb.	.3075/ .3125
LMM-801, -803	lb.	.2125/ .2175
-804, -811	lb.	.245 / .25
-807	lb.	.215 / .22
Marblette 76, 77	lb.	.50 / .60
Foam resin 1076	lb.	.50 / .60
Plenco foundry resins	lb.	.27 / .35
Molding cmpds. gen. purpose	lb.	.185 / .235
Heat resist.	lb.	.19 / .24
Improved impact	lb.	.225 / .28
Min. bleed	lb.	.185 / .195
Radio & TV	lb.	.20 / .215
Stock	lb.	.205 / .34
Reichhold Foundry Resins:		
Corciment	lb.	.135 / .17
Corovit	lb.	.275 / .31
Foundrez, core binder liquids	lb.	.21 / .25
Shell molding liquids	lb.	.195 / .245
Powders	lb.	.2675/ .3025
Plyophen molding cmpds.:		
5440, 5596, 5655, 5660	lb.	.30 / .325
5510, 5510-C	lb.	.34 / .365
5657, 5658, 5661	lb.	.315 / .34
Reilly general purpose	lb.	.195 / .20
Heat & impact resist.	lb.	.20 / .205
Resinox molding compounds:		
Gen. purpose & heat resist	lb.	.205 / .215
Impact	lb.	.255 / .3225
Low elec. loss	lb.	.31 / .365
Special grade	lb.	.215 / .255
Rogers phenolic molding compounds:		
RX 425	lb.	.29 / .295
Special colors	lb.	.34 / .405
RX 428	lb.	.355 / .36
Special colors	lb.	.42 / .465
RX 429	lb.	.365 / .37
Special colors	lb.	.395 / .48
RX 431	lb.	.4125/ .4175
Special colors	lb.	.455 / .55
RX 438	lb.	.4675/ .4725
RX 441, 455	lb.	.32 / .325
RX 442	lb.	.3475/ .3525
RX 447	lb.	.5025/ .51
RX 448	lb.	.355 / .36
RX 458	lb.	.38 / .385
RX 469	lb.	.365 / .37
RX 470, 480	lb.	.40 / .405
RX 478, 488	lb.	.415 / .43
RX 525, 545	lb.	.29 / .295
RX 530	lb.	.4125/ .4175
Special colors	lb.	.42 / .475
RX 547	lb.	.37 0 .375
RX 625	lb.	.395 / .40
RX 628	lb.	.455 / .46
Schenectady shell mold resins	lb.	.26 / .28
Synvar molding compounds, PM series	lb.	.205 / .2625
Synvaren 640	lb.	.30 / .335
920	lb.	.21 / .245
935	lb.	.195 / .23
9203, 9203A	lb.	.173 / .208
Synvaren liquid industrial resins:		
675	lb.	.29 / .325
920	lb.	.21 / .245
CP-66	lb.	.19 / .225
PBL-2	lb.	.33 / .365
PBL-218S	lb.	.27 / .305
Synvarite GW-1000	lb.	.34 / .36
GW-1080, PBL-F, PBL-718	lb.	.37 / .39
GW-2400	lb.	.375 / .395
PBL-100	lb.	.31 / .33
PBL-108FF	lb.	.38 / .40
PBL-210, PBL-3301	lb.	.36 / .38
PBL-410	lb.	.33 / .35
PBL-3311	lb.	.35 / .37
PNL-12HL/11 PNL-156HL/24	lb.	.3025/ .3225
PNL-159H, PNL-169H	lb.	.29 / .31
PNL-169PD, PNL-179PD	lb.	.28 / .30
PNL-355PD	lb.	.315 / .335
PNL-1279HL	lb.	.2875/ .3075
PT	lb.	.32 / .34
Toolplastik No. 8000	lb.	.48 / .72

Polyamide

Fiberfil Nylon G, natural	lb.	1.70 / 1.90
Standard colors	lb.	1.80 / 2.20
Nylatron G, GS	lb.	1.75 / 2.00
Spencer Nylon 400, 401, 402	lb.	1.33 / 1.50

60, 602	lb.	$1.48 /	$1.65
601	lb.	1.95 /	2.10
603, 604	lb.	1.83 /	2.00
Versamid 115	lb.	.64 /	.82
Zytel molding powder	lb.	1.435 /	1.60

Polyesters

Acme 1-501	lb.	.82 /	.93
1-501A	lb.	.87 /	.98
1-503	lb.	2.75 /	3.50
1-510	lb.	.89 /	1.00
Atlac 363E-02Z, -12Z	lb.	.66 /	.69
-32Z	lb.	.68 /	.71
382E	lb.	.57 /	.60
FP	lb.	.66 /	.69
Bakelite Polyester resins	lb.	.35 /	.75
Diall 50-01	lb.	2.90 /	3.00
50-51	lb.	3.25 /	3.50
50-52	lb.	3.50	
51-01	lb.	.87 /	.98
52-01	lb.	2.25 /	2.50
52-20-30	lb.	1.50	
Diall 50-01, 50-51, 50-52	lb.	2.75 /	3.50
51-01	lb.	.87 /	.98
52-01	lb.	1.95 /	2.50
52-20-30	lb.	1.30 /	1.50
Fibercore 1000, 2000	lb.	.50 /	.65
3000	lb.	.55 /	.70
G-E polyesters			
AR 401	lb.	.35 /	.365
AR 403, 480	lb.	.34 /	.355
AR 403 LS, 480 LS	lb.	.355 /	.37
AR 493	lb.	.40 /	.415
AR 499	lb.	.435 /	.45
AR 501	lb.	.455 /	47
Hetron	lb.	.43 /	.485
IC-312, -400, -514, -548, -625, -730, -800	lb.	.35 /	.385
-312-2	lb.	.365 /	.38
-336, -382, -706	lb.	.37 /	.385
-401	lb.	.44 /	.455
-420	lb.	.355 /	.37
-433	lb.	.38 /	.395
-636, -670	lb.	.48 /	.495
-638, -689	lb.	.55 /	.565
-670-2	lb.	.50 /	.515
-671	lb.	.405 /	.42
Filled resins	lb.	.255 /	.54
Laminac 4110	lb.	.33 /	.345
4111	lb.	.45 /	.465
4116	lb.	.33 /	.345
4120	lb.	.39 /	.405
4123, 4128	lb.	.34 /	.355
4134	lb.	.46 /	.475
4146	lb.	.43 /	.445
4192	lb.	.355 /	.37
4202	lb.	.55 /	.565
Marco resins:			
CEL-101, Marcothix 1, 3	lb.	.50 /	.515
Marcothix 5, 7, 8	lb.	.46 /	.475
Marcothix 9, MR-31C, -31V	lb.	.37 /	.385
Marcothix 10, MR-28C, -28V, -37C, -37CX	lb.	.33 /	.345
MR-28CS	lb.	.35 /	.365
MR-28H, -41R	lb.	.36 /	.375
MR-28R,-42R	lb.	.34 /	.355
MR-28RL, -37RL	lb.	.355 /	.37
MR-30C	lb.	.44 /	.455
MR-33C	lb.	.53 /	.545
MR-40R	lb.	.38 /	.395
MR-60C	lb.	.41 /	.425
MR-61H	lb.	.42 /	.435
Mylar, rolls, types A & C	lb.	2.50 /	4.80
Type D	lb.	3.00 /	3.30
Sheets, type A	M. sq. in.	.09 /	1.11
Type C	M. sq. in.	.09 /	.15
Type D	M. sq. in.	.53 /	1.34
Plaskon 911, 920	lb.	.55 /	.665
941, 942, 951, 9411	lb.	.35 /	.465
943	lb.	.41 /	.525
9404	lb.	.365 /	.48
9406	lb.	.355 /	.465
9500, 9510, 9511	lb.	.35 /	.465
9600	lb.	.44 /	.555
Polycast 2	sq. ft.	1.89 /	5.18
3	sq. ft.	1.08 /	18.00
6	sq. ft.	.66 /	3.10
7	sq. ft.	.72 /	7.18
CR-39	sq. ft.	1.25 /	20.00
Polylite 8000, 8001, 8005, 8007, 8017, 8037, 8173, 8200	lb.	.34 /	.355
8006, 8008, 8009, 8039, 8166	lb.	.35 /	.365
8016, 8100	lb.	.365 /	.38
8050	lb.	.41 /	.425
8061, 8065	lb.	.44 /	.455
8120	lb.	.48 /	.495
8150	lb.	.45 /	.465
8170, 8237	lb.	.38 /	.395
8180, 8181	lb.	.36 /	.375
8400	lb.	.56 /	.575
Pre-Imp	lb.	.68 /	.85
Thermaflow 100, 200, 300	lb.	.48 /	.82
400, 500	lb.	.52 /	.87
1,000, 2,300	lb.	.34 /	.55
2,400	lb.	.36 /	.58
Vibrin 114, 117, 152, 154	lb.	.34	
115A	lb.	.38	
121	lb.	.46	
135	lb.	3.00	
142	lb.	$0.50	
151	lb.	.35	
152LS-4	lb.	.355	
153	lb.	.40	
X-1633-A	lb.	.49	
X-1636-W	lb.	.585	

Polyethylene

A-C No. 6, 617	lb.	.30 /	$0.37
No. 6A, 7, 617A	lb.	.35 /	.42
No. 615, G-201	lb.	.38 /	.45
No. 629	lb.	.40 /	.47
No. 729	lb.	.45 /	.52
Alathon	lb.	.41 /	.505
Bakelite DE Series	lb.	.43 /	.725
DYGT	lb.	.54 /	.69
DYLT, DYNF, DYNH	lb.	.41 /	.59
DYNJ	lb.	.44 /	.62
DYNK	lb.	.45 /	.63
Catalin 15-5	lb.	.41 /	.59
Celanese polyethylene sheeting:			
Extruded rolls, 44 in. wide	lb.	.56 /	1.12
Sheets, 44 x 60 in.	sheet	.83 /	8.76
Petrothene 100, 110, 200, 201, 202, 203, 210, 211, 213, 301, 312, 322	lb.	.41 /	.51
310, 320	lb.	.45 /	.55
310-BK-3, 320-BK-3, 320-BK-½, 320 colors	lb.	.53 /	.63
311, 321	lb.	.43 /	.53
311-BK-3, 312-BK-3, 322-BK-3 322-BN-1	lb	.375 /	.48
311-BK-½, 321-BK-3, 321-BK-½, 321-BN-1	lb.	.46 /	.56
321 colors	lb.	.50 /	.60
560	lb.	.38 /	.48
Poly-Eth 1007, 1008.5, 1408.5, 2007, 2206, 2215, 2235, 2236, 2256, 2405, 2425, 2455	lb.	.35 /	.49
Hi-D 1504, 1506, 2504	lb.	.42 /	.56
3215, 5005	lb.	.375 /	.515
3405	lb.	.38 /	.52
4005, 4225	lb.	.41 /	.55
4202, 5003, 5202	lb.	.51 /	.66
Reynolon 1000, P series	lb.	.60 /	.80
Tenite Group 1	lb.	.41 /	.45
Group 2	lb.	.43 /	.47
Group 3	lb.	.46 /	.50
Group 4	lb.	.39 /	.43
Group 5, 6	lb.	.50 /	.72
Group 7	lb.	.60 /	.82
Group 8	lb.	.70 /	.92

Silicone

Bakelite GMGA-5001, -5002	lb.	2.75 /	3.10
5003	lb.	4.00 /	4.35
5004	lb.	5.40 /	5.75

Styrenes

Ampacet, crystal	lb.	.315 /	.335
Colors, std.	lb.	.345 /	.365
Special	lb.	.345 /	.75
Pearl	lb.	.41 /	.75
Phosphorescent	lb.	.695 /	1.00
Tinsel	lb.	.41 /	.67
Confetti	lb.	.51 /	.70
Bakelite BMC series, nat.	lb.	.45 /	.685
Colors	lb.	.50 /	.735
BMS, SMD series, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	.52
RMD series, nat.	lb.	.45 /	.685
Colors	lb.	.50 /	.735
TGD series	lb.	.33 /	.35
Colors, std.	lb.	.36 /	.38
Special	lb.	.36 /	1.00
TMD series	lb.	.33 /	.40
Colors, std.	lb.	.36 /	.43
Special	lb.	.36 /	1.00
Catalin, high impact, natural	lb.	.325 /	.355
Colors, std.	lb.	.355 /	.385
Special	lb.	.36 /	1.00
Medium impact, natural	lb.	.325 /	.355
Colors, std.	lb.	.355 /	.385
Special	lb.	.355 /	1.00
Regular grade, crystal	lb.	.305 /	.325
Colors, std.	lb.	.345 /	.365
Special	lb.	.345 /	1.00
Utility black	lb.	.18 /	.235
Cycolac compounds:			
Natural powders	lb.	.58 /	.66
Natural & std. color pellets	lb.	.65 /	.73
Special color pellets	lb.	.68 /	.76
Darex Copolymer 3	lb.	.47 /	.67
43G	lb.	.39 /	.58
X34	lb.	.42 /	.61
Latices 3L	lb.	.415 /	.56
610L	lb.	.30 /	.46
3020	lb.	.32 /	.47
Dow Latex, polystyrene	lb.	.30 /	.46
Latices, styrene/ Resins PS-2&3	lb.	.25 /	.35
butadiene	lb.	.30 /	.46
Dylite, expandable beads	lb.	$0.50 /	$0.60
Fiberfil Styrene G, natural	lb.	.55 /	1.00
Standard colors	lb.	.65 /	2.00
Koppers, Fibertuff	lb.	.55 /	1.505
MC-185 series	lb.	.33 /	.355
-300 series	lb.	.33 /	1.005
-400 series	lb.	.355 /	1.005
Regular, crystal	lb.	.295 /	.315
Colors, std.	lb.	.335 /	.355
Special	lb.	.335 /	1.005
Pearl	lb.	.41 /	1.005
Phosphorescent	lb.	.695 /	2.005
Kralastic, std. colors	lb.	.50 /	1.10
Lustrex Hi-Flow 55, crystals	lb.	.295 /	.31
Hi-Test 88, std.	lb.	.36 /	.38
Special colors	lb.	.36 /	1.00
L, crystals	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
LHA, std.	lb.	.355 /	.375
Special	lb.	.355 /	1.00
Utility black, gen. purpose	lb.	.18 /	.185
High impact	lb.	.235 /	.24
Medium impact	lb.	.19 /	.195
Marbon resins	lb.	.39 /	.46
Plio-Tuf C75, R100	lb.	.37 /	.45
G85	lb.	.52 /	.59
P100, std. colors	lb.	.41 /	.45
Polycast 4	sq. ft.	2.56 /	11.07
Styron 475, natural	lb.	.33 /	.35
Colors, std.	lb.	.36 /	.38
Special	lb.	.36 /	1.00
Sheets, std.	lb.	.55 /	.60
Special	lb.	.55 /	.62
480, natural black	lb.	.38 /	.40
Colors, std.	lb.	.41 /	.43
Special	lb.	.41 /	1.00
647, crystal	lb.	.305 /	.32
Colors, special	lb.	.345 /	1.34
66, 688, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
700, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
777 colors, std.	lb.	.355 /	.375
Special	lb.	.355 /	1.00

Urea

Admirez Foundry Resins, SP-30	lb.	.27	
UP-50	lb.	.105	
Beetle C-4980 Brown	lb.	.1875/	.30
No fines granulation	lb.	.2075/	.32
T-298 Black	lb.	.1875/	.30
MUP series, powder	lb.	.30 /	.49
Special colors	lb.	.30 /	.59
Granules	lb.	.33 /	.52
Special colors	lb.	.33 /	.62
Foundrez core binder	lb.	.105 /	.14
Plaskon molding cmpds.:			
Black & Brown	lb.	.1875/	.30
Other colors	lb.	.30 /	.62
Foundry resins, liquid	lb.	.10 /	.13
Powdered	lb.	.2325/	.2525
Sylplast molding cmpds., granules	lb.	.33	
Powder	lb.	.30	

Vinyls

Bakelite QG-5909	lb.	.35 /	.585
QG-5921	lb.	.41 /	.645
5924	lb.	.43 /	.665
QYNA, QYSM, QYSQ	lb.	.27 /	.47
QYNV	lb.	.30 /	.50
QYSJ	lb.	.28 /	.48
VG-1914, 1918	lb.	.37 /	.056
1985	lb.	.35 /	.585
5507	lb.	.31 /	.545
5544	lb.	.405 /	.64
5911	lb.	.315 /	.55
5980	lb.	.32 /	.555
7734	lb.	.28 /	.515
9031	lb.	.265 /	.50
9530	lb.	.275 /	.51
9960, 9970, 9980	lb.	.335 /	.57
VAGH	lb.	.55 /	.75
VMCH	lb.	.41 /	.61
VYDR, VYNW	lb.	.27 /	.47
VYHH	lb.	.32 /	.52
VYLF	lb.	.36 /	.56
VYNS	lb.	.44 /	.64
VYNV	lb.	.32 /	.52
Blacar No. BW-60	lb.	.315 /	.385
NEMA colors	lb.	.355 /	.425
No. BW-80	lb.	.405 /	.455
NEMA colors	lb.	.445 /	.495
No. PC white, ivory, black	lb.	.285 /	.335
Other colors	lb.	.325 /	.375
Darex Everplex A (wet wt.)	lb.	.21 /	.39
B (wet wt.)	lb.	.22 /	.40
G (wet wt.)	lb.	.21 /	.39
Copolymer Y (wet wt.)	lb.	.245 /	.28
PVA Emulsions (wet wt.)	lb.	.19 /	.355
Diamond PVC-45, -50	lb.	.27 /	.33
Dow PVC-100, -111	lb.	.38 /	.57
Exon 402A, 500, 905, 915, 925	lb.	.31 /	.51
450, 468R, 480	lb.	.35 /	.55
461	lb.	9.75	
468	lb.	.33 /	.53
470	lb.	.55	
471	lb.	.50	
654	lb.	.34 /	.54

Formvar	lb.	$0.865	$1.03
Gelva emulsions	lb.	.19	.205
Granules	lb.	.4175	.617
Geon 101, 101EP, 103EP, 202	lb.	.27	.45
	lb.	.30	.48
121	lb.	.28	.46
126	lb.	.41	.59
400X110	lb.	.37	.55
404HI	lb.	.32	.50
409, 426, 427, 428	lb.	.425	.525
503H (polyblend)	lb.	.315	.55
2042, 2046	lb.	.365	.60
Colors	lb.	.345	.58
6373	lb.	.395	.63
Colors	lb.	.325	.56
6461	lb.	.375	.61
Colors	lb.	.33	.565
8372	lb.	.38	.615
Colors	lb.	.33	.565
8539, 8726	lb.	.35	.585
Colors	lb.	2.00	2.75
8590, 8591, 8592, 8593, 8594, 8595	lb.	.275	.51
8600	lb.	.325	.56
Colors	lb.	.27	.505
8620	lb.	.32	.555
Colors	lb.	.425	.66
8630	lb.	.475	.71
Colors	lb.	.35	.585
8640	lb.	.32	.555
8650	lb.	.435	.67
8677	lb.	.425	.66
8700A, 8750	lb.	.455	.69
Colors	lb.	.605	.84
8720	lb.	.33	.565
8737	lb.	.295	.53
8740	lb.	.29	.525
8749	lb.	.44	.675
8800	lb.	.275	.51
8801	lb.	.325	.56
Colors	lb.	.33	.565
8802	lb.	.38	.615
Colors	lb.	.29	.525
8804	lb.	.45	.685
8807	lb.	.37	.605
8809	lb.	.275	.55
8810	lb.	.315	.51
8812, 8813, 8814, 8815	lb.	.26	.32
Geon Latex 151, 251	lb.	.32	.38
351	lb.	.28	.34
352	lb.	.37	.43
552, 652	lb.	.39	.45
450x167	lb.	.365	.405
576	lb.	.505	.655
Krene, film	lb.	.49	.645
Sheeting	lb.	.34	.625
Marvinols: NF-1005	lb.	.275	.56
NF-1055, 3520	lb.	.41	.645
NF-3020	lb.	.38	.665
NF-3025	lb.	.3375	.6225
NF-3040	lb.	.37	.605
NF-3045, 3050	lb.	.285	.57
NF-3055	lb.	.29	.575
NF-3060	lb.	.30	.585
NF-3065	lb.	.265	.50
NF-3070, 3075, 3080	lb.	.29	.525
NF-3085, 3090, 3095	lb.	.36	.595
NF-3505, 3515	lb.	.34	.575
NF-3510	lb.	.44	.675
NF-4005	lb.	.42	.705
NF-4010, 4015, 4020	lb.	.40	.655
NF-5015, 5020	lb.	.33	.585
NF-5025	lb.	.29	.545
NF-5030	lb.	.39	.685
NR-6015	lb.	.39	.675
NR-6020	lb.	.50	.735
NR-7002, 7045, 7060	lb.	.28	.47
VR-10			
VR-12, -20, -21, -22, -24, -30	lb.	.27	.46
VR-50	lb.	.30	.49
Opalon 300, 300FM	lb.	.31	.51
410	lb.	.34	.54
505	lb.	.35	.55
Inj. molding cmpds.	lb.	.29	.67
Profile extrusion cmpds.	lb.	.29	.72
Wire cmpds.	lb.	.29	.67
Plastiflex, std.	lb.	.90	1.10
Novelty	lb.	1.15	1.50
Pliovic AO (dispersion)	lb.	.30	.32
DB80V, DB90V, EDB90V	lb.	.27	.29
Latex 300	lb.	.30	.35
Reynolon, 4000 series	lb.	1.55	2.30
Rolls, 1-mil	sq. yd.	.0625	.11
Colors	sq. yd.	.0675	.08
4-mil	sq. yd.	.215	.3125
Colors	sq. yd.	.2375	.255
16-mil	sq. yd.	.81	1.19
Colors	sq. yd.	.86	.945
Satinflex	lb.	$1.15	$1.50
Vygen 110, 120	lb.	.27	.31
1101, 1150	lb.	.425	.50
2201	lb.	.48	.55

Vinylidine

Dow Latex 744-B	lb.	.26	.42
Resin 565	lb.	.39	.525
Saran formulation 115, black, nat.	lb.	.39	.52
Colors	lb.	.44	.69
720 nat.	lb.	.41	.54
Colors	lb.	.46	.71
747 nat.	lb.	.395	.525
761 nat.	lb.	.39	.52
Colors	lb.	.44	.69
820 nat.	lb.	.42	.55
Colors	lb.	.47	.60
Latices	lb.	.45	.61
Resin F 120	lb.	.58	.65
F242	lb.	.64	.70

Solvents

Enjay acetone	lb.	.08	.115
Ethyl ether	gal.	.44	
Isopropyl acetate	lb.	.11	.145
Isopropyl alcohol 91%	gal.	.37	.60
95%	gal.	.39	.62
Anhydrous	gal.	.41	.64
Isopropyl ether	gal.	.30	.51
Methyl ethyl ketone	lb.	.12	.155
Secondary butyl acetate	lb.	.1175	.1525
Secondary butyl alcohol	lb.	.12	.155

Stabilizers

Advastab B-13-P, BC-105, BC-147	lb.	.75	.80
BC-12, C-77, C-79, E-82	lb.	.90	.95
BC-74, BC-30	lb.	.70	.75
BZ-51, L paste, Z-6, Z-15	lb.	.65	.70
BZ-155	lb.	.69	.74
C-21	lb.	1.00	1.05
CH-101, CH-201	lb.	.60	.65
CZ-11	lb.	.95	1.00
E-98	lb.	.53	.58
JCX	lb.	.62	.67
SN	lb.	.47	.52
T-10, T-52	lb.	1.90	1.95
T-17M	lb.	2.95	3.00
T-50LT	lb.	3.20	3.25
T-52N	lb.	1.80	1.85
T-72, T-671	lb.	2.65	2.70
Argus Mark C	lb.	.88	.95
E	lb.	.72	.85
M	lb.	.68	.74
PL	lb.	.63	.69
TT	lb.	.72	.86
WS	lb.	.98	1.11
X	lb.	2.50	2.75
XI	lb.	.87	1.01
XV	lb.	.92	.99
XX	lb.	.58	.65
Barca 10	lb.	.75	.80
Baker barium ricinoleate	lb.	.70	
Calcium ricinoleate	lb.	.55	
Zinc vicinoleate	lb.	.60	
Dutch Boy Barinac	lb.	.70	
Calstar	lb.	.37	
Clarite A	lb.	.83	
B	lb.	.68	
CS-137	lb.	1.25	
DS-207	lb.	.55	
Dyphos	lb.	.58	.595
50A	lb.	.34	
Dythal	lb.	.395	.41
Leadstar	lb.	.39	
Lectro 60	lb.	.2525	
Normal lead maleate	lb.	.4475	
Normasal	lb.	.46	
Pearlescent pigment	lb.	1.00	
Plumb-O-Sil-A	lb.	.3075	
-B	lb.	.325	.37
-C	lb.	.3475	.375
Provinite A	lb.	.83	
B	lb.	.68	
Tribase	lb.	.275	
-E	lb.	.2225	
Trimal	lb.	.435	
Ferro 182	lb.	.70	.76
200	lb.	1.31	1.43
203, 900, 1820	lb.	.88	1.00
503	lb.	.28	.40
541A	lb.	.80	.92
700	lb.	$0.47	$0.59
703, 1972	lb.	.63	.75
823	lb.	2.50	2.75
840	lb.	3.25	
903	lb.	.58	.70
909	lb.	.91	1.01
1203	lb.	1.30	1.40
1206	lb.	1.23	1.33
1212	lb.	.68	.80
1825	lb.	.98	1.10
1840	lb.	.73	.85
1976	lb.	.45	.57
Harshaw 1-V-3	lb.	.43	
1-V-4	lb.	.68	
1-V-7	lb.	.66	.71
2-V-4	lb.	.85	.90
2-V-7	lb.	1.10	1.15
2-V-8	lb.	1.30	
2-V-400	lb.	.80	.85
5-V-1	lb.	.41	
5-V-22	lb.	.49	
7-V-1	lb.	.90	.95
7-V-2	lb.	.95	1.00
7-V-4	lb.	1.18	1.23
8-V-1	lb.	1.10	1.15
8-V-5	lb.	.80	.85
8-V-100	lb.	.84	.89
9-V-1	lb.	.76	.81
12-V-5	lb.	.75	
22-V-1	lb.	1.28	
24-V-1	lb.	1.28	1.33
28-V-2	lb.	1.18	
128-V-5	lb.	.86	
281-V-4	lb.	.90	
Merix AST Concentrate 1001	lb.	.355	1.75
Metasap 613-A	lb.	.69	
613-B	lb.	.84	
613-C	lb.	1.06	
621	lb.	.88	
624	lb.	.75	
Cadmium stearate	lb.	1.40	1.44
Fused stearates, calcium 602-A	lb.	.25	.30
Dibasic lead stearate	lb.	.56	
Lead 611	lb.	.32	.37
Lead stearate	lb.	.39	.44
Nuostable V-1	lb.	.54	.59
V-2	lb.	.39	.44
V-10	lb.	.70	.75
V-20	lb.	1.30	1.35
V-21	lb.	1.29	1.34
V-30	lb.	.90	.95
V-31	lb.	.80	.85
V-40	lb.	1.18	1.23
V-42	lb.	.65	.70
V-43	lb.	.75	.80
V-44	lb.	.90	.95
V-45	lb.	1.10	1.15
V-50	lb.	.49	.54
V-60	lb.	.37	.42
V-70	lb.	.68	.73
V-80	lb.	2.80	2.85
V-81	lb.	2.90	2.95
Permyl A	lb.	.45	.57
Stabelan 110, 120	lb.	.65	.75
115, HR paste	lb.	.85	.95
E	lb.	1.35	1.50
HR-50	lb.	.75	.90
HR liquid	lb.	.65	.75
Powder	lb.	.95	1.05
XL	lb.	.55	.65
Staflex QMXA	lb.	.70	
50% in DOP	lb.	.52	
OY	lb.	1.00	1.20
Stayrite #10	lb.	.33	.37
#15	lb.	.54	.57
#20	lb.	.38	.42
#22	lb.	1.32	1.34
#25	lb.	.36	.40
#70, 75, 80, 90	lb.	.69	.70
#229	lb.	.47	.50
P-10	lb.	.40	.44
Thermolite 12	lb.	2.00	2.25
13	lb.	3.10	3.78
15	lb.	4.13	
17	lb.	2.45	2.75
20	lb.	2.95	3.25
39	lb.	2.75	3.25
91	lb.	3.00	
Vanstay C-73 S.	lb.	.63	.65
HT	lb.	.90	.92
L	lb.	.33	.35
LN	lb.	.98	1.00
R	lb.	.70	.72
Z	lb.	.67	.69

Wetting Agents

Advawet 212	lb.	.45	.50
Poly-lube No. 4	gl.	1.45	1.94